VETERINARY MEDICINE

A Monthly Magazine Devoted to the Promotion of the Art and Science of Veterinary Medicine

Vol. XLV APRIL 1950 No. 4

Published Monthly by the

VETERINARY MAGAZINE CORPORATION

Suite 803, Livestock Exchange Building
Kansas City 15, Missouri, U.S.A.
Telephone: Victor 2985

EDITOR

ROBERT L. ANDERES, B.S., D.V.M.

CONSULTING EDITOR

D. M. CAMPBELL, D.V.S.

DEPARTMENT EDITORS

R. R. DYKSTRA, D.V.M.
Manhattan, Kansas
A. O. FOSTER, B.A., M.A., Sc.D.
Beltsville, Maryland
W. R. HINSHAW, D.V.M., Ph. D.
Frederick, Maryland

REPRESENTATIVES

H. J. Mostyn, P. O. Box 391, Dover, N. J.
G. W. Campbell, 43 E. Northrup, Buffalo, N. Y.

SUBSCRIPTION RATES: One year, $5.00; two years, $8.75; three years, $12.00; five years, $18.00. Single copy, 50c. U. S. Currency. Postage prepaid. Authorized agents will present letter of collection authority. Pay no money to others.

Entered as second class matter at the post office at Kansas City, Missouri. Entered as second class matter under the title of the American Journal of Veterinary Medicine, July 19, 1910, at Chicago, Illinois, under the Act of March 3, 1879.

All matter appearing in this publication is copyrighted. No part of it may be reproduced without written permission. Permission will be given if the purpose is unobjectionable. If there be any question as to the propriety of reproduction the author will be consulted.

CHANGE OF ADDRESS: Prompt notice of change of address is requested to assure accurate mailing, giving old and new address. Address all communications to Veterinary Medicine, Suite 803, Livestock Exchange Bldg., Kansas City 15, Missouri.

AUTHOR-CONTRIBUTORS: Articles submitted for publication are accepted as original communications and with the understanding that they are not submitted to other journals. Manuscripts should be clearly typed, double spaced with wide margins, and sheets numbered consecutively. See prior issues for style. Tables and charts should be simple and clearly illustrate the text material.

Copyright, 1950, by the Veterinary Magazine Corporation, Kansas City 15, Missouri.

In This Issue . . .

Influenza in Swine—George A. Young, Jr. 141

Problems in Cattle Practice—W. J. Gibbons 147

The Neutralizing Effect of Antiserum from Recovered Carriers of Equine Infectious Anemia on the Virus of the Disease—C. D. Stein and D. W. Gates 152

A Study of Canine Encephalitis, with Special Reference to Clinical, Bacteriological and Postmortem Findings—R. L. Burkhart, G. C. Poppensiek, and A. Zink 157

Pseudostertagia Bullosa (Ransom and Hall, 1912) Orlov, 1933, from New Mexico Sheep, with a Note on the Gubernaculum—O. Wilford Olsen 163

Treatment of Skin Diseases with Ichor—Samuel Bender 164

In Vitro Diffusion of Penicillin Ointments for Bovine Mastitis—V. P. Seeberg and J. P. Street 167

The Prophylaxis and Therapy of Hepatic Coccidiosis in the Rabbit by the Administration of Sulfonamides—E. H. Peterson 170

Editorial Comments . . .

Veterinary Clinics for Large Animals 162
Effect of Thyroprotein on Swine 166
Diseases of Newborn and Young Pigs 173
Food Producing Livestock or Game 173
Blood Test for Tuberculosis 173
Animal Protein Factor—Utilization of Feed 174
Air Transportation Creates New Problems 174
Stethoscopic Heart Record 179
Feeding Turkey Heads to Mink XXX
Black Hamprace Hog Established as a New Breed XXXII

Poultry Practice Problems—W. R. Hinshaw 175

Principles of Animal Health—R. R. Dykstra 176

Veterinary Parasitology—A. O. Foster 177

Abstracts of Literature . . .

Experimental Effect of Aureomycin in Leptospirosis 178
Canine Hysteria not Induced Experimentally in Dogs Fed Flour Bleached with Chlorine Dioxide 178
Infectious Keratitis in Cattle 178

Clinical Reports . . .

Large Melanoma in a Bullock—C. A. McGaughey 179

Veterinary Items of Interest 180

Obituary . . .

George C. Supplee 169

Coming Meetings XXXIV

Necrology XXXVIII

VETERINARY MEDICINE

A Monthly Magazine Devoted to the Promotion of the Art and Science of Veterinary Medicine

Vol. XLV APRIL 1950 No. 4

Published Monthly by the

VETERINARY MAGAZINE CORPORATION

Suite 803, Livestock Exchange Building
Kansas City 15, Missouri, U.S.A.
Telephone: Victor 2985

EDITOR

ROBERT L. ANDERES, B.S., D.V.M.

CONSULTING EDITOR

D. M. CAMPBELL, D.V.S.

DEPARTMENT EDITORS

R. R. DYKSTRA, D.V.M.
Manhattan, Kansas
A. O. FOSTER, B.A., M.A., Sc.D.
Beltsville, Maryland
W. R. HINSHAW, D.V.M., Ph. D.
Frederick, Maryland

REPRESENTATIVES

H. J. Mostyn, P. O. Box 391, Dover, N. J.
G. W. Campbell, 43 E. Northrup, Buffalo, N. Y.

SUBSCRIPTION RATES: One year, $5.00; two years, $8.75; three years, $12.00; five years, $18.00. Single copy, 50c. U. S. Currency. Postage prepaid. Authorized agents will present letter of collection authority. Pay no money to others.

Entered as second class matter at the post office at Kansas City, Missouri. Entered as second class matter under the title of the American Journal of Veterinary Medicine, July 19, 1910, at Chicago, Illinois, under the Act of March 3, 1879.

All matter appearing in this publication is copyrighted. No part of it may be reproduced without written permission. Permission will be given if the purpose is unobjectionable. If there be any question as to the propriety of reproduction the author will be consulted.

CHANGE OF ADDRESS: Prompt notice of change of address is requested to assure accurate mailing, giving old and new address. Address all communications to Veterinary Medicine, Suite 803, Livestock Exchange Bldg., Kansas City 15, Missouri.

AUTHOR-CONTRIBUTORS: Articles submitted for publication are accepted as original communications and with the understanding that they are not submitted to other journals. Manuscripts should be clearly typed, double spaced with wide margins, and sheets numbered consecutively. See prior issues for style. Tables and charts should be simple and clearly illustrate the text material.

Copyright, 1950, by the Veterinary Magazine Corporation, Kansas City 15, Missouri.

In This Issue . . .

Influenza in Swine—George A. Young, Jr. 141

Problems in Cattle Practice—W. J. Gibbons 147

The Neutralizing Effect of Antiserum from Recovered Carriers of Equine Infectious Anemia on the Virus of the Disease—C. D. Stein and D. W. Gates 152

A Study of Canine Encephalitis, with Special Reference to Clinical, Bacteriological and Postmortem Findings—R. L. Burkhart, G. C. Poppensiek, and A. Zink 157

Pseudostertagia Bullosa (Ransom and Hall, 1912) Orlov, 1933, from New Mexico Sheep, with a Note on the Gubernaculum—O. Wilford Olsen 163

Treatment of Skin Diseases with Ichor—Samuel Bender 164

In Vitro Diffusion of Penicillin Ointments for Bovine Mastitis—V. P. Seeberg and J. P. Street 167

The Prophylaxis and Therapy of Hepatic Coccidiosis in the Rabbit by the Administration of Sulfonamides—E. H. Peterson 170

Editorial Comments . . .

Veterinary Clinics for Large Animals 162
Effect of Thyroprotein on Swine 166
Diseases of Newborn and Young Pigs 173
Food Producing Livestock or Game 173
Blood Test for Tuberculosis 173
Animal Protein Factor—Utilization of Feed 174
Air Transportation Creates New Problems 174
Stethoscopic Heart Record 179
Feeding Turkey Heads to Mink XXX
Black Hamprace Hog Established as a New Breed XXXII

Poultry Practice Problems—W. R. Hinshaw 175

Principles of Animal Health—R. R. Dykstra 176

Veterinary Parasitology—A. O. Foster 177

Abstracts of Literature . . .

Experimental Effect of Aureomycin in Leptospirosis 178
Canine Hysteria not Induced Experimentally in Dogs Fed Flour Bleached with Chlorine Dioxide 178
Infectious Keratitis in Cattle 178

Clinical Reports . . .

Large Melanoma in a Bullock—C. A. McGaughey 179

Veterinary Items of Interest 180

Obituary . . .

George C. Supplee 169

Coming Meetings XXXIV

Necrology XXXVIII

Influenza In Swine*

GEORGE A. YOUNG, JR., B.A., D.V.M., Austin, Minnesota

THE title, influenza in swine, immediately brings to mind the typical swine influenza or swine flu—a disease that by definition depends for its etiology upon the concerted action of swine influenza virus and a bacterium, *Hemophilus influenzae suis*[1]. This typical disease is characterized by rapid onset, high morbidity and relatively low mortality. In veterinary practice, mild respiratory disturbances are not often diagnosed as influenza, even though swine are very probably subject to swine influenza infections in the absence of secondary bacteria, and to infections by other members of the influenza group such as human influenza viruses. Because of the mild nature of these illnesses, evidence of the occurrence of natural infection in adult swine with human influenza viruses[2,3] has apparently received little attention. Since few adult swine die or become seriously ill, this indifference may seem to be justified from an economic standpoint. However, when it is considered that influenza virus infection may be an important contributor to the heavy losses occurring among newborn pigs throughout the corn belt each year, the disease assumes great economic importance. It is the purpose of this article to point out some of the specific problems which, in the opinion of the author, face the swine industry as a result of this disease.

The failure to associate respiratory disease in swine with the human influenza viruses is perhaps a result of an unfortunate tendency to classify all influenza viruses isolated from swine influenza virus regardless of their antigenic characteristics. Since the swine influenza viruses are as closely related antigenically to the human A viruses as many of the human A viruses are to each other[4,8], it would appear desirable to classify them according to serological types regardless of the species from which they are derived.

The term swine flu originated with Koen[9] who noted similarities of the disease in swine and in man following the 1918 pandemic. In 1930 Shope[1] isolated an agent from swine which seemed to be related serologically[10] to the human pandemic virus of 1918. This same relationship has also been suggested by Laidlaw[11]. Somewhat later, in studies on swine at two New Jersey state farms, Shope[2] found further evidence that human influenza virus may attack swine under natural conditions. He found antibodies capable of neutralizing human influenza virus to be present in the sera of older swine but absent in the sera of young swine on these farms. The older animals had lived through a winter in which a respiratory disease was prevalent among the human inmates of the two institutions. The young pigs were born after these outbreaks. Shope believed that the swine whose sera were capable of neutralizing human influenza virus had undergone an unrecognized human influenza virus infection acquired from man. Similar observations have been made by Shaw, *et al.*[3] Also of great interest is the work reported by Francis, *et al.*[12], who found antibodies in man that would neutralize an A prime influenza virus isolated from hogs in Korea. These findings suggest that swine may provide a reservoir for viruses capable of infecting man. Thus the possibility exists that there is a constant interchange of infective agents between swine and man. If this is true, the epidemiological prob-

The accompanying article on influenza of swine by Doctor Young should prove of major interest to veterinarians wherever swine are raised.

While the intertransmissibility of human and swine influenza has been well accepted by our veterinary scientists, the importance of this information may not be fully appreciated by veterinary practitioners, swine raisers and public health workers.

This brilliant and comprehensive report also contributes one more essential piece of information toward clarifying the complex riddle of the specific cause of sickness and losses in baby pigs. In addition, it scientifically substantiates the well established opinion that swine influenza infection has a direct bearing on sow fertility, early abortions and poor quality litters.—A. H. Quin, D.V.M.

*From the swine disease section of the Hormel Institute, University of Minnesota, Austin. Hormel Institute publication no. 48 and paper no. 694 of the Miscellaneous Journal Series of the Minnesota Agricultural Experiment Station.

lem is one that has been suggested previously[10,11], yet is scarcely recognized.

Serological studies made in our laboratory[13] on sera obtained by random sampling of swine throughout Minnesota and Iowa indicate that an influenza virus serologically related to Weiss human type A[14] is currently manifesting itself in these farm animals. As judged by hemagglutination inhibition antibody titers, this virus is as prevalent in swine as Shope's no. 15[15] swine influenza virus. Since the Shope virus has been able to maintain itself in swine at least since 1930, the finding in swine of more recently recognized human influenza viruses and their maintenance within that species, may indicate the existence of an interepidemic virus reservoir. From the veterinary standpoint, the effect of such viruses on swine is more important than the potential effect on man, except where man may transmit the virus inadvertently to a swine herd.

Active Infection in Baby Pigs

It has been pointed out already that although human types of influenza virus may attack swine, the disease is so mild that an illness may not be detected by the herdsman[2, 3]. From experimental results and also from general observations, it is quite clear that natural resistance to influenza infection is greater in older swine. Thus the most serious consequences of the disease are to be found in young pigs.

Young pigs have been shown to be susceptible to experimental infections with both human and swine influenza. The ages of the pigs in which infections were produced were not constant, however. American workers[16, 17] have infected pigs from six to 14 weeks of age, while European workers[18, 19] have found it necessary to use younger pigs to get transmission of the human influenza viruses. Since the experiments have been isolated ones, and the age of the pigs has varied with each experiment, the results do not permit a conclusion as to the specific relationship between age of animal and resistance to the experimental disease. In work with standard strains of mice and virus, Kalter[20] has shown that three-week-old mice are 10,000 times as susceptible to influenza as 25-week-old mice, with gradients of susceptibility extending from three to 25 weeks. Thus an age factor is of obvious importance in natural resistance of mice and quite likely of equal importance in swine.

Under natural conditions very young pigs may contract influenza and die while running with adults that show no symptoms. Such a situation was studied serologically in a herd in which 50% of ten-day-old pigs died[12]. Although the dams nursing these pigs showed no signs of illness, comparative tests on sera taken from them at the peak of illness of the pigs and again ten days later showed a fourfold increase in hemagglutination inhibition titer for a type A human influenza virus. An increase in titer of that magnitude is considered adequate proof that influenza infection has occurred.

Further evidence of the susceptibility of young swine to human influenza viruses was found in another herd in which similar losses occurred among five to seven-day-old pigs. In this case, the herdsman was in the initial stage of a marked upper respiratory infection at the time the pigs were farrowed. It is probable that his infection was transmitted to the baby pigs. This possible relationship is an important one for the practitioner to remember when he encounters an obvious epizootic in a closed herd, since the herdsman rather than the older swine may well be the source of infectious material.

Apparently, at least one factor other than age, plays a part in natural resistance to influenza infections. Recent work in our laboratory[21] has indicated that the absence of vitamin D in the diet of mice for a four-week period increased their susceptibility to swine influenza virus infection. Only small amounts of vitamin D were necessary, however, to correct the diet, and the addition of more than ten USP units of vitamin D to 100 gm. of the diet did not further increase resistance. To what extent these findings will be useful in the field of swine diseases remains to be shown, but they do suggest that virus diseases and nutritional problems may be interrelated.

Adult swine may acquire resistance to influenza virus infection through the development of specific antibodies as a result of active infection. Since the disease is not severe in older animals, the necessity of acquiring resistance is not great. However, in young animals, where infection is more intense, resistance becomes a very important matter in cases where the pigs are exposed to influenza virus. The newborn pig, before it suckles its dam, is devoid of influenza antibody[22,23], and is highly vulnerable to attack. Some type of protection must therefore be obtained if that individual is

to survive or show normal growth should it be unfortunate enough to be born in an environment contaminated with influenza.

Some resistance may be acquired by the newborn pig through the colostrum of its dam, providing the dam has had previous experience with influenza infection[34]. The passive immunity to influenza infection acquired by a newborn pig from nursing an immune dam, however, is not an absolute immunity. Circulating antibody alone has been shown incapable of warding off infection; it only modifies the disease by decreasing its intensity[35]. True immunity is acquired only by actual contact of the susceptible cells of the host with the virus, resulting in local cell adaptation, in addition to circulating antibodies. Even this type of immunity is not permanent. In subsequent attacks by the virus, however, antibodies prevent a severe infection, and the adapted cells recover more quickly. Thus the newborn pig, although it has acquired antibodies from its dam, still lacks the conditioned epithelial cells, and infection, though modified by antibodies, may still be of a serious nature or even fatal.

For the past two years a study has been under way in our laboratory to determine to what extent the influenza viruses affect suckling swine. Attempts have been made to immunize the dam against swine influenza virus so that antibodies may be passed to the young at birth to give them some degree of protection[34]. The work thus far reported was done with only one strain of swine influenza virus (Shope's no. 15). The beneficial effects of vaccination have been somewhat limited. A degree of protection for young pigs can be obtained by vaccination of the dam with live swine influenza virus previous to gestation, providing the agent attacking the pigs at birth or during the first few weeks of life is similar in its antibody complex to the swine influenza virus. If, however, a virus antigenically dissimilar from the attacking virus were used for immunization, little if any protection could be expected. At the present time it is not known whether vaccination of the dam against influenza viruses would significantly reduce baby pig losses throughout the swine belt. Our present knowledge of incidence and type of infection in both young and adult swine is inadequate for an evaluation of the over-all problem.

The diagnosis of influenza in newborn or very young pigs is difficult. In the case of adult stock in which there is no mortality, it is possible, by means of serological tests on acute and convalescent sera, to determine whether an influenza virus infection had occurred. Hemagglutination inhibition, serum neutralization, or complement fixation tests will reveal any significant increase in influenza antibodies in such sera. In the newborn or very young animal, however, such demonstration of shifts in antibody titer are not practical because antibodies do not develop rapidly and death often occurs before they have a chance to develop. In such cases isolation of the virus is the only means now known of making specific diagnosis of active infection. Isolation of the virus entails the use of ferrets, hamsters, mice, or embryonated eggs, and even with these as tools, the establishment of a diagnosis may require many weeks. Recent developments in the field of histochemistry[36], however, suggest the possibility that influenza virus may eventually be demonstrated in tissues by the same histochemical methods as mumps virus and rickettsia have been demonstrated.

Diagnosis of influenza in young swine by symptomatology is also difficult since different strains of virus apparently manifest themselves somewhat differently. In the young ani-

Under natural conditions very young pigs may contract influenza and die while running with adults that show no symptoms.

mal, gross pathological changes such as lung consolidation, may not occur. If it does occur, usually only a small portion of the lung is involved. The presence of secondary bacteria in some infections and their absence in others also may complicate the symptomatology.

There is no specific treatment for influenza infection in swine. Specific sera are not available commercially, and if they were, it is not likely they would be sufficiently effective to justify the cost of treatment. The general concept is that currently available antibiotics are not effective against virus infections†. In some cases, however, antibiotics are useful in reducing secondary bacterial populations so that the disease may assume a milder course.

Effect of Influenza in the Dam on the Pig Crop

There are apparently several indirect effects that the influenza viruses may have upon a potential pig crop; such as, (1) sterility of the dam or slowness to come into heat following an influenza infection, (2) mid-term abortion, and (3) neonatal mortalities among the pigs. These conditions are often attributed indirectly to swine influenza infection but so far there have been no specific laboratory proofs of such effects, and for lack of information and suitable technics, such laboratory proof is indeed difficult to get. However, it is possible to hypothesize how these effects may come about.

For many years practitioners and swine herdsmen have suspected a relationship between sterility or delayed breeding in gilts and sows and a preceding infection of swine influenza. The relationship appears to be a valid one, but there is at present no explanation as to how an influenza infection may bring about sterility. Since there is some relationship between resistance to influenza and vitamin D intake[21], it is possible that the steroids, including the sex hormones, are involved in natural resistance, since they are very closely related chemically to vitamin D. It has been shown that ovarian cyst fluid[15,27] contains substances which inhibit hemagglutination by the influenza viruses. It is not known whether ovarian cyst fluid shows increased ability to inhibit hemagglutination of the influenza viruses following recovery of an animal from an influenza infection. Such increased ability to inhibit hemagglutination might also adversely affect or retard the developing ova.

Abortion in swine is most frequently associated with brucellosis. It is often observed, however, that sows or gilts that abort show insignificant agglutination titers for *Brucella abortus*. For example, we recently had occasion to study sera from a herd of 29 gilts, 21 of which had a history of abortion[28]. Tests with *Br. abortus* antigen showed only two of the animals with titers, and these reacted only at a 1:10 dilution. Since the farmer gave a history of clinical influenza in this group of gilts, both in November and again in February, the sera were examined for the presence of hemagglutination inhibition antibodies against six common influenza viruses. Tests were made, using as formalized antigens Shope's no. 15 swine influenza virus, human type A virus strains, Weiss, PR-8, and Thompson, a human type A prime strain, FM-1, and a human type B strain, Lee. Antibodies were found in sera for both the Weiss and FM-1 antigens but not for the swine, Thompson, PR-8, or Lee antigens. Correlation of the titers shown by the gilts and the occurrence of abortion showed a very close relationship to the Weiss type infection. Statistically, the odds were greater than 1:100 that this distribution of the Weiss titers in the gilts as related to abortions would occur by chance. These findings imply that human influenza virus was a factor in these porcine abortions. The titers for FM-1 type revealed no relationship with occurrence of abortion.

It has not been possible up to this time to determine exactly how abortions are caused by influenza viruses. More is known, however, about this effect of the influenza viruses than about their relationship to sterility. One thing that appears important is the stage of development of the embryo and its placental tissues. Data gathered thus far suggest that after the placental tissues are formed the likelihood of direct or indirect damage to the developing embryo is much lessened. Because of this timing factor, it becomes important to the practitioner to understand that the embryo is not engulfed in protective placental tissues immediately after conception, and that there is a period of vulnerability in the development of the embryo. The most vulnerable stage would appear to be the nutritive stage, that is, from the time of conception up to about the fourteenth day when the amnion forms the first protective coat around the embyro. This thin, simple membrane is the only protection that the embryo has until completion of the allantois around the thirtieth to thirty-fifth day. A common error is to assume protection for the

†Finland, *et al.*, *Am. Jour. Med.*, 8:21, 1950, have recently reported that aureomycin is effective in the treatment of influenza in man.

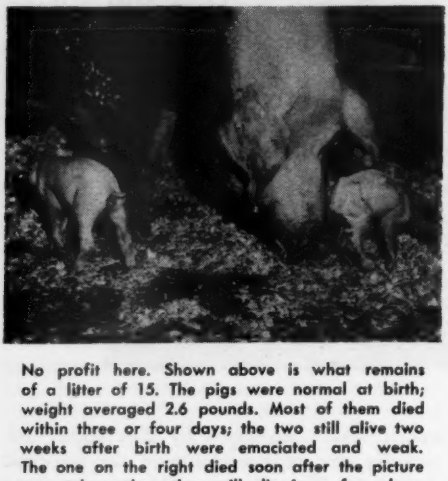
embryo as soon as the blastocyst begins its development. This organ in actuality is only an extension from the embryonic disc and the embryo remains exposed to the uterine contents up to closure of the amnion[29, 30]. Thus when we think of placental protection for developing swine embryos, we must remember that the embryo is not completely protected by five tissue layers until at least 30 days after conception.

It is unlikely that the influenza viruses causing abortion actually invade the embryonic tissues. Several researchers[31,32,33] have shown that it is unusual for the influenza virus to be transported by the blood stream. More likely the effect is a toxic manifestation[34] or a product of the virus particle or the host cell, or a reaction due to soluble antigens[35], or an allergic response in animals previously infected[36, 37]. Since timing is important in relation to the developing embryo, it is possible that soluble antigenic substances may impregnate the embryo in its early developmental stage before neutralizing antibody to those antigens is developed by the dam. Since the embryo develops so rapidly, impregnation of the embryo could occur before closure of the amnion, or amnion and allantois, so that the embryo would contain antigens that could not react with antibody developed by the mother because of the impermeability of the placental tissues[22, 28]. Thus the sensitized embryo would be incompatible with the serum of its dam. Minimal leakage of antibody across the placental barrier might precipitate abortion.

It has been pointed out that active infection in newborn swine may take place so rapidly as to cause death within the first few days. The incubation period of some of the influenza viruses is less than 12 hours and the maximum number of virus particles is often present after 48 hours. However, we do see a type of loss among baby pigs which apparently has no infectious entity. This type of loss is generally attributed to faulty nutrition of the dam preceding and during gestation. However, in these cases it would be well to look into the herd history to determine if possibly one of the influenza viruses may have been involved indirectly in these pig losses.

The incompatibility between the developing embryo and the dam, as hypothesized above, may carry through until birth. Thus when a newborn pig sensitized by specific antigen, feeds on antibody-rich colostrum which contains the corresponding specific antibody, disastrous results are apt to occur. The tendency of antigens to concentrate in the von Kupffer

cells of the liver, and the ordinary capillary endothelium, as well as in the cells of the kidney, heart, smooth muscle, and the steriod forming cells in the adrenal cortex and ovary[25] could also be a characteristic of antigens contributing to the seriousness of the antigen-antibody reaction in the newborn, since vital centers are involved. The seriousness of such an incompatibility is exemplified by one of our experiments in which we injected dams with swine influenza virus combined with soluble



No profit here. Shown above is what remains of a litter of 15. The pigs were normal at birth; weight averaged 2.6 pounds. Most of them died within three or four days; the two still alive two weeks after birth were emaciated and weak. The one on the right died soon after the picture was taken; the other will die in a few days.

antigen from infected allantoic fluid[24]. Five dams so injected during the first week of pregnancy farrowed 50 apparently normal pigs at term, but only four of the 50 were weaned, suggesting that the virus had indirectly effected 92% mortality in the pigs from these five litters.

The practical usefulness of this information on influenza in swine to the practitioner would seem limited. A disease which is relatively benign for adults yet assumes high pathogenicity for the young, one for which the symptoms are diverse and diagnosis difficult, and one for which there is no specific treatment, presents a discouraging obstacle to the practitioner. Accepting these objections, the above information nevertheless offers to the veterinarian an explanation of baby pig losses other than the classical one of dietary deficiency, and on as sound a basis. Quite often a client objects to having baby pig losses associated with poor management or feeding on his part, especially when he has done all he can to provide good housing and diets for the dams. By careful questioning, it is frequently possible to obtain a herd history from which evidence of disease as a contributing factor may be used to ease a delicate situation. Suggestions by the veterinarian for corrections in the diet to increase resistance to infection may be much better received than the same suggestions based on nutritional deficiencies alone.

Summary

In the foregoing article, the author has attempted to put across to the reader several points which he believes are pertinent in the consideration of influenza as a disease in swine. It is suggested that swine are vulnerable to attack by many of the influenza viruses that attack man. Although these diseases may be very mild in adult swine, they may assume serious intensity in very young swine, resulting in heavy losses among the latter. It is also pointed out that influenza infection in the dam may have a disastrous effect on a potential pig crop causing infertility of the dam, abortion, or neonatal mortality.

REFERENCES

1. Shope, R. E., Swine Influenza. III. Filtration Experiments and Etiology. *Jour. Exp. Med.*, 54:373, 1931.

2. Shope, R. E., Serological Evidence for the Occurrence of Infection with Human Influenza Virus in Swine. *Jour. Exp. Med.*, 67:739, 1938.

3. Shaw, D. R., Stokes, J., Jr., and Kenney, A. S., Serologic and Immunologic Studies Relative to the Viruses of Human and Swine Influenza. *Am. Jour. Med. Sci.*, 197:247, 1939.

4. Smith, W., Andrewes, C. H., and Laidlaw, P. P., Influenza: Experiments on the Immunization of Ferrets and Mice. *Brit. Jour. Exp. Path.*, 16:291, 1935.

5. Francis, T., Jr., and Shope, R. E., Neutralization Tests with Sera of Convalescent or Immunized Animals and the Viruses of Swine and Human Influenza. *Jour. Exp. Med.*, 63:645, 1936.

6. Magill, T. P., and Francis, T., Jr., Antigenic Differences in Strains of Human Influenza Virus. *Proc. Soc. Exp. Biol. and Med.*, 35:463, 1936.

7. Shope, R. E., Immunological Relationship Between the Swine and Human Influenza Viruses in Swine. *Jour. Exp. Med.*, 66:151, 1937.

8. Magill, T. P., and Francis, T., Jr., Antigenic Differences in Strains of Epidemic Influenza Virus: I. Cross-neutralization Tests in Mice. *Brit. Jour. Exp. Path.*, 19:273, 1938.

9. Shope, R. E., Infection of Ferrets with Swine Influenza Virus. *Jour. Exp. Med.*, 60:49, 1934.

10. Shope, R. E., The Incidence of Neutralizing Antibodies for Swine Influenza Virus in the Sera of Human Beings of Different Ages. *Jour. Exp. Med.*, 63:669, 1936.

11. Laidlaw, P. P., Epidemic Influenza: A Virus Disease. *Lancet*, 1:1118, 1935.

12. Francis, T., Jr., Quilligan, J. J., Jr., and Minuse, E., Resemblance of a Strain of Swine Influenza Virus to Human A-prime Strains. *Proc. Soc. Exp. Biol and Med.*, 71:216, 1949.

(*Reference list continued on page* 151)

Problems In Cattle Practice*

W. J. GIBBONS, D.V.M., M.S., Auburn, Alabama

THE life of the practicing veterinarian is beset, at all times, by the problems of his clients involving their livestock. The ability of the practitioner to cope with these problems determines, to a large measure, his success and the esteem in which he is held by his community. Despite careful research, disease investigation, and the successful solution of many veterinary problems, new difficulties are constantly arising and many of the old ones seem to stay with us.

In dairy cattle practice, the veterinarian is usually confronted with four chief problems. In most dairy herds, breeding and sterility troubles are constantly in the foreground. In surveys conducted by extension workers, particularly those concerned with artificial insemination, among dairy herd owners, breeding problems are usually listed as presenting the greatest difficulty. Calf diseases, and mastitis, too, are public enemies for most dairymen, while brucellosis is still an enigma to many owners of cattle.

In summarizing statistics on cattle diseases presented during the past two years at the Large Animal Surgical and Ambulatory Clinics at the Alabama Polytechnic Institute, the list of problem diseases is lengthy. Diseases listed because of large number of cases or because of uncertain prevention and treatment include: arsenic (cotton dust) poisoning, anaplasmosis, acetonemia, bloat, enteritis, malnutrition, mastitis, mycotic stomatitis, parasitisms, photosensitization, post-parturient diseases, including the milk fever complex, sterility, screw worms, and hyperkeratosis (X disease).

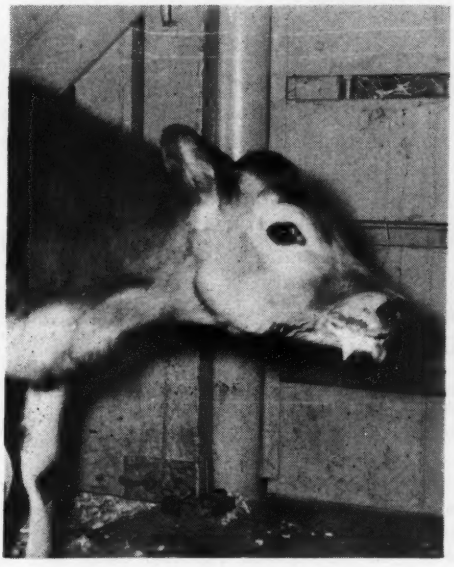
The losses from arsenical poisoning, from dusting cotton, in the Southeast are tremendous and we have planned some work using British anti-lewisite (BAL) as an antidote. We have found nothing better in the treatment of anaplasmosis than repeated blood transfusions, using at least a gallon of citrated blood daily. X disease is still of unknown etiology, although the incidence of the disease in the South seems to be decreasing.

Discussion of cattle disease problems necessarily must be limited, and only three conditions will be briefly outlined here.

*Presented at the Kansas Veterinary Medical Association meeting, Topeka, Jan. 30-Feb. 1, 1950.

Mycotic Stomatitis, Soremouth in Cattle

During this past summer, there has been considerable anxiety, and some economic loss, due to a disease of cattle causing sore mouths and other lesions. Anxiety has been widespread due to the fear that this condition might be a contagious disease, possibly causing losses similar to those of foot-and-mouth disease, which might put cattlemen out of business. Reports circulated that this was a new and deadly disease were totally unfounded.



Mycotic stomatitis in a yearling heifer showing profuse salivation frequently observed in these cases.

Mycotic stomatitis occurs chiefly in pastured animals, affecting one or a few of the herd. It is frequently reported in the United States, Canada and Europe. In the United States, it was described as early as 1904, and has been found in certain areas from year to year. In the fall of 1948, numerous outbreaks were observed in northwest Georgia, southeastern Tennessee and northern Mississippi. In some pasture seasons, such as last year, the disease becomes very prevalent. The cause is not proved but there is considerable evidence that it is due to moulds and fungi on forage. These

moulds and fungi are supposed to produce acrid, chemical substances which are responsible for the lesions. From the supposed cause, the disease is termed mycotic stomatitis, and from the lesions, aphthous stomatitis. Due to frequent scares caused by mistaken diagnosis,

Mycotic stomatitis in a two-year-old Hereford heifer demonstrating the crusts that frequently develop on the muzzle, around the nostrils and lips. This condition has been observed over a widespread area during the course of recent years. It is not contagious.

it is sometimes termed pseudo foot-and-mouth disease. This malady produces ulcers and necrosis of the membrane of the mouth and crusting of the muzzle. Affected cattle frequently appear stiff, develop sores on the teats, skin of the back, and around the feet. A few animals show pharyngitis and croupous enteritis. The disease affects from one to a few animals in the herd and is not contagious.

The disease has been reported in all of the southern states. In Alabama, many cases have appeared on ergotized and mouldy Dallis grass, and also on velvet grass, crimson clover, alfalfa and other grasses and legumes used on improved pastures. An occasional case has appeared on native pasture.

In handling this disease, remove all sick animals to a barn or dry lot. Mowing pastures will usually remove rank grass and mouldy seed heads. In areas where the disease appeared in 1948, and mowing was practiced in 1949, the incidence of the disease was low. Careful nursing of the sick animals, as regards feed and water and swabbing the mouth with antiseptics, will suffice in the majority of cases.

Mortality is low and recovery usually occurs in ten to 14 days following removal from pasture. Systemic treatment, in many cases, with pyribenzamine or similar antihistamine seems to hasten recovery. These agents should be given orally (50 mg. per 100 lb.). Many veterinarians are of the opinion that phenylmercuric succinimide, (125 cc. of 1:1,000 sol.) intravenously is helpful, while others believe sodium iodide intravenously is followed by good results. Sulfonamide preparations and penicillin, in most cases, are not of any particular benefit.

Along with mycotic stomatitis, there have been reports of vesicular stomatitis affecting cattle in Texas and South Carolina. The stomatitis existing in Alabama did not in any known case spread through the herd or affect horses or mules.

Milk Fever and Acetonemia

In the field of post-parturient diseases, the practitioner is still confronted with relapsing cases of milk fever and persistent cases of acetonemia. The addition of magnesium and phosphorus to calcium gluconate injections is not the complete answer to the milk fever problem. Deaths still occur during and shortly after treatment, relapses are not uncommon and in these there is an almost complete failure to respond to treatment.

Deaths and failure to respond to treatment, in many cases, are probably due to poor technic in medication and the lack of a proper diagnosis. The administration of calcium solutions too rapidly, too cold, or too concentrated, to animals in a weakened state, frequently results in calcium shock and may end fatally.

Lack of a careful examination in post-parturient patients may lead to a wrong diagnosis or, more frequently, to a failure to diagnose a complicating condition. Failure to recognize septic metritis, septic mastitis, gangrenous mastitis, general debility, coxofemoral dislocation, unknown paraplegia, or even meningitis and paralytic rabies, is a frequent pitfall. The diagnosis of accompanying acetonemia is extremely important. In high producing cows, about 40% of milk fever is complicated with acetonemia.

The causes of milk fever fatalities in our practice include calcium shock, use of amphetasul intravenously before calcium therapy,

cardiac embolism, renal embolism, liver degeneration from acetonemia, inhalation pneumonia and other post-partum diseases.

In the treatment of milk fever, the solutions of calcium salts should not be over 20% calcium gluconate diluted with 40% dextrose or some combination of calcium and dextrose in not too high concentration. Solutions of calcium gluconate in strength of 23 to 26% injected rapidly are dangerous. It is recommended that these be injected with a gravity intravenous outfit using no larger than a 15 ga. 1½ to 2 in. needle. The cow is stimulated ten minutes before treatment with 20 to 30 cc. of caffeine and sodio-benzoate, 15 cc. of metrazol

Photo courtesy Dr. J. T. Alston

In high producing cows, about 40% of milk fever is complicated with acetonemia.

or 20 to 30 cc. of coramine. Five to ten minutes after injection the cow is given 5 cc. of amphetasul or prophetamine subcutaneously. Attempts to induce the cow to rise are started 15 minutes later.

In relapsing cases of milk fever, the Sulkowitch test should be employed to determine if the cow needs additional calcium. Our limited experience with chlorethamine compound does not justify any positive conclusions. In a series of 15 cases in which chlorethamine was administered with calcium as an initial treatment, no relapses occurred. In diagnosing relapsing milk fever, a careful search should be made for complicating acetonemia, metritis, mastitis and other conditions which retard recovery or simulate milk fever symptoms. Some authorities even suggest that an occasional relapse may be histamine toxicity.

Acetonemia still presents a major problem in dairy cows. While much progress has been made in our understanding of this disease, the basic cause of the liver degeneration and disturbed metabolism is still in doubt. In dealing with acetonemia clinically, diagnosis is still important in respect to distinguishing between secondary and primary or clinical acetonemia.

Secondary acetonemia appears in many diseases in which metabolism is disturbed by food intake to such a degree that the blood sugar level lowers and acetone bodies rise in the blood stream enough to give a reaction to the Ross test of the urine. Secondary acetonemia is found in toxic conditions, digestive disturbances, and ofttimes in mycotic stomatitis.

The modified Ross test applied to the urine, diluted 1:10, is positive in true or primary acetonemia and negative or indefinitely positive in secondary acetonemia. For years, in trying to simplify work in connection with acetonemia, milk has been used as a test fluid with indifferent results. In a good clinical case of acetonemia, a positive test for acetone bodies in milk can be produced as follows: To 5 cc. of milk add 2.5 gm. of double strength nitroprusside mixture (2 gm. of sodium nitroprusside with 98 gm. of ammonium sulfate); when dissolved, add 1 cc. of concentrated ammonium hydroxide solution. A pink or lavender color indicates a positive reaction.

In the treatment of acetonemia, nothing so far surpasses injections of dextrose in the form of 500 cc. to 1,000 cc. of 40 to 50% anhydrous corn sugar. In some persistent cases, 10 cc. of anterior pituitary like (A.P.L.) hormone has appeared to be beneficial. Vitamin A has proved valueless in our experience. Chloral hydrate is indicated in nervous cases and as a follow-up treatment in many cases. Henderson has shown that cobalt sulfate may be useful in some areas. Research work has indicated that the addition of cobalt to dextrose solutions is not indicated, as cobalt, to be of value, must pass through the rumen. A good treatment for acetonemia consists in the administration of 500 cc. of dextrose (50% solution) intravenously, followed by the daily administration for three to six days of 2 oz. of ferro-cobalt mixture plus 15 gm. of chloral hydrate in water.

Mastitis

The control of mastitis is a very prominent problem in most dairy herds. The incidence of mastitis, caused by various organisms, is so high that most workers, intensively concerned with this disease, doubt that the malady can ever be completely eradicated from any large dairy herd. As long as one infected quarter remains, there will always be danger of mastitis outbreaks unless control is constant and absolute.

The control of mastitis, while to a consider-

able extent a dairyman's problem, cannot be successfully carried out without sound counsel and cooperation of the client's veterinarian. No plan of control should be advocated without reasonable assurance of cooperation on the part of the dairyman. The veterinarian should explain fully to the client the nature of mastitis infection, the process by which it attacks the functional tissue of the udder, and the means by which it is spread from cow to cow. The veterinarian should survey the animal husbandry practices of any dairy herd, regardless of size or method of milking, and point out to the owner practices which are liable to spread mastitis.

The following factors are involved in mastitis control:

A. The dairyman
   1. Sanitary milking
   2. Prevention of udder injuries
   3. Proper use and care of milking machines
   4. Milking infected cows last
   5. Selling badly infected cows

B. For the veterinarian:
   1. Diagnosis of infected quarters
   2. Treatment of infected quarters

In herds of some size, which are badly infected, the following plan offers promise:

1. All cows should be examined for infection before drying off.

2. All infected quarters should be treated during the drying off period.

3. If a diagnosis is not possible, all four quarters of cows being dried off should be treated.

4. All fresh cows should be checked for mastitis as soon as possible after freshening (two weeks).

5. During the milking period, a check diagnosis should be made every three months.

6. The herdsman should be constantly on guard against any evidence of mastitis in the milking herd.

7. All "flare-up" quarters should be treated immediately and the cow milked by hand.

8. All "flare-up" quarters should be checked within at least 30 days after treatment to ascertain if "cured".

The Treatment of Mastitis

In the dairy cattle under our supervision, it has been found that the infection in the majority of herds is a mixed infection of various streptococci and staphylococci. As an example, in one dairy, 47 quarters were found infected. Laboratory examination revealed the following infections: streptococci 15, staphylococci 16, streptococci and staphylococci ten, and coliform six.

The use of penicillin in ointment or oil solution will work well in quarters infected with streptococci but has not been the answer in other infections. The use of penicillin combined with sulfonamides in aqueous or oily

In the dairy cattle under our supervision, it has been found that mastitis in the majority of herds is a mixed infection of various organisms.

solutions has proved effective, especially when two or three injections are made. These preparations can also be used to advantage in acute cases or springer cows. They have not proved effective against coliform infections where streptomycin seems to be the proved remedy.

Preparations most commonly used in the large animal clinics and the method of use include the following:

1. Penicillin ointment, two injections at 24 hour intervals—(100,000 units penicillin in 7.5 gm. of ointment base).

2. Procaine penicillin G in oil, two injections at 24 hour intervals—(100,000 units per 10 cc. peanut oil).

3. 100,000 units penicillin in 50 cc. of 25% sulfamethazine or 12% sulfamerazine solution, two or three injections at 24 hour intervals.

4. 100,000 units penicillin in 50 cc. of 5% sulfamethazine and 5% sulfamerazine solution, two or three injections at 24 hour intervals.

5. Streptomycin, 0.5 gm. in 20 cc. saline, three or four injections at 24 hour intervals.

6. In many cases, a specific diagnosis is impossible. In both acute and chronic cases, when such is the case, a combination used to

good effect is, 5 gm. streptomycin with 1,000,000 to 2,000,000 units aqueous penicillin in 500 cc. of 5% sulfamethazine and 5% sulfamerazine. Give two treatments at 24 hour intervals.

7. For the past several months we have been using aureomycin on laboratory and clinical mastitis. In the treatment of a series of quarters showing clinical mastitis with 213 mg. of aureomycin in 7.1 gm. ointment, only 50% recoveries were recorded. In advanced cases of mastitis, the results were negligible. All treated quarters were cultured before treatment and at seven, 14, and 21 day intervals after treatment. In cases not recovering, a distinct decrease in the number of bacteria and leukocytes was always noted, particularly at the end of seven days.

The above results would seem to indicate that the fault was in the dosage. We are now using 426 mg. of aureomycin at one dose and in bad cases, repeating in 48 hours. Preliminary results would indicate that this drug will be very useful in the control of mastitis when administered in proper dosage.

▼ ▼ ▼

Influenza In Swine

(*Continued from page* 146)

13. Young, G. A., Jr., and Underdahl, N. R., Unpublished data.

14. Salk, J. E., Menke, W. J., and Francis, T., Jr., Identification of Influenza Virus Type A in Current Outbreak of Respiratory Disease. *Jour. Am. Med. Assn.*, 124:93, 1944.

15. Shope, R. E., Swine Influenza. I. Experimental Transmission and Pathology. *Jour. Exp. Med.*, 54:349, 1931.

16. Shope, R. E., and Francis, T., Jr., The Susceptibility of Swine to the Virus of Human Influenza. *Jour. Exp. Med.*, 64:791, 1936.

17. Mote, J. R., and Fothergill, L. D., The Effect of Human Strains of *Hemophilus influenzae* on Influenza Virus Infections of Swine. *Jour. Bact.*, 40:505, 1940.

18. Elkeles, G., Experimentelle Untersuchungen zur Atiologie der Influenza, Mededeelingen uit het Instituut voor Praeventieve Geneeskunde, p. 60, 1934.

19. Tulloch, W. J., Observations on the Virus of Influenza, with a View to Elaborating a Simple Diagnostic Test whereby its Presence in the Respiratory Tract of Man may be Revealed. *Edin. Med. Jour.*, 46:117, 1939.

20. Kalter, S. S., The Effect of Age upon Susceptibility to Infection with Influenza Virus. *Jour. Immunol.*, 63:17, 1949.

21. Young, G. A., Jr., Underdahl, N. R., and Carpenter, L. E., Vitamin D Intake and Susceptibility of Mice to Experimental Swine Influenza Virus Infection. *Proc. Soc. Exp. Biol. and Med.*, 72:695, 1949.

22. Young, G. A., Jr., and Underdahl, N. R., Swine Influenza as a Possible Factor in Suckling Pig Mortalities. II. Colostral Transfer of Hemagglutinin Inhibitors for Swine Influenza Virus from Dam to Offspring. *Cornell Vet.*, 39:120, 1949.

23. Young, G. A., Jr., and Underdahl, N. R., Neutralization and Hemagglutination Inhibition of Swine Influenza Virus by Serum from Suckling Swine and by Milk from Their Dams. In press.

24. Young, G. A., Jr., and Underdahl, N. R., Swine Influenza as a Possible Factor in Suckling Pig Mortalities. III. Effect of Live Virus Vaccination of the Dam against Swine Influenza on Suckling Pig Mortalities. *Cornell Vet.*, 50:24, 1950.

25. Francis, T., Jr., and Stuart-Harris, C. H., Studies on the Nasal Histology of Epidemic Influenza Virus Infection in the Ferret. III. Histological and Serological Observations on Ferrets Receiving Repeated Inoculations of Epidemic Influenza Virus. *Jour. Exp. Med.*, 68:813, 1938.

26. Coons, A. H., and Kaplan, M. H., Localization of Antigen in Tissue Cells. II. Improvements in a Method for the Detection of Antigen by Means of Fluorescent Antibody. *Jour. Exp. Med.*, 91:1, 1950.

27. McCrea, J. F., In press. See, Fazekas de St. Groth. Modification of Virus Receptors by Metaperiodate. I. The Properties of IO_4^--Treated Red Cells. *Aust. Jour. Exp. Biol. and Med.*, 27:65, 1949.

28. Young, G. A., Jr., and Kernkamp, H. C. H., Unpublished data.

29. Heuser, C. H., A Study of the Implantation of the Ovum of the Pig from the Stage of the Bilaminar Blastocyst to Completion of the Fetal Membranes. *Contrib. Embryol.*, 19:229, 1927.

30. Heuser, C. H., and Streeter, G. L., Early Stages in the Development of Pig Embryos, from the Period of Initial Cleavage to the Time of the Appearance of Limb-buds. *Contrib. Embryol.*, 20:1, 1929.

31. Orcutt, M. L., and Shope, R. E., The Distribution of Swine Influenza Virus in Swine. *Jour. Exp. Med.*, 62:823, 1935.

32. Rickard, E. R., and Francis, T., Jr., The Demonstration of Lesions and Virus in the Lungs of Mice Receiving Large Intraperitoneal Inoculations of Epidemic Influenza Virus. *Jour. Exp. Med.*, 67:953, 1938.

33. Scott, J. P., Swine Influenza Associated with Hog Cholera. *Vet. Ext. Qtly.*, 82, Univ. of Pa. Bul., 41:3, 1941.

34. Henle, G., and Henle, W., Studies on the Toxicity of Influenza Viruses. I. The Effect of Intracerebral Injection of Influenza Viruses. *Jour. Exp. Med.*, 84: 623, 1946. II. The Effect of Intra-abdominal and Intravenous Injection of Influenza Viruses. *Jour. Exp. Med.*, 84:639, 1946.

35. Wiener, M., Henle, W., and Henle, G., Studies on the Complement Fixation Antigens of Influenza Viruses Types A and B. *Jour. Exp. Med.*, 83:259, 1946.

36. Bull, D. R., and Burnet, F. M., Experimental Immunization of Volunteers Against Influenza Virus B. *Med. Jour. Aust.*, 1:389, 1943.

37. Henle, W., Henle, G., Stokes, J., and Maris, E. P., Experimental Exposure of Human Subjects to Viruses of Influenza. *Jour. Immunol.*, 52:145, 1946.

38. Kaplan, M. H., Coons, A. H., and Deane, H. W., Localization of Antigen in Tissue Cells. III. Cellular Distribution of Pneumococcal Polysaccharides Types II and III in the Mouse. *Jour. Exp. Med.*, 91:15, 1950.

▼ ▼ ▼

Despite all that has been done in the past, hog cholera is still costing farmers from $20,000,000. to $40,000,000. a year. Some competent authorities estimate the annual bill at $65,000,000.

The Neutralizing Effect Of Antiserum From Recovered Carriers Of Equine Infectious Anemia On The Virus Of The Disease

C. D. STEIN, V.M.D., and D. W. GATES, V.M.D., M.S.*

NEUTRALIZATION technics have been used to advantage in studies of a number of the common virus diseases of domestic animals such as rabies[1], vesicular stomatitis[2], hog cholera[3], equine encephalomyelitis[4], and equine influenza[5, 6], but only to a limited extent in studies of equine infectious anemia.

Neutralization studies of the virus of the last-mentioned disease by Russian investigators from 1935 to 1937 were described by Kaljakow[7] in 1940. These investigators made three *in vivo* tests and one *in vitro* test, using antisera from hyperimmunized carriers that had been inactivated by treatment with phenol or heat.

In the first and second *in vivo* tests, the antiserum and virus were administered simultaneously to test horses in proportions of 4 to 1 and 10 to 1, respectively; control horses received only virus. The controls developed symptoms of the disease after a short incubation period, and three of the four test horses in the two experiments likewise developed symptoms, but only after an incubation period of 58 to 83 days. The fourth test horse showed no symptoms for six months but it was later determined to be affected with the subclinical form of the disease. In the third *in vivo* experiment two test horses were used. One was injected with 200 cc. of the antiserum and exposed to 100 cc. of virus ten days later. The second horse received a preliminary injection of 200 cc. of antiserum followed by 200 cc. 12 days later. This horse was given 100 cc. of virus 20 days after the first injection. Both animals, together with a control horse that received only the 100 cc. virus injection, developed typical symptoms of the disease after a short incubation period.

In the *in vitro* experiment, 190 cc. of the antiserum was mixed with 10 cc. of virus, held at room temperature for 48 hours, and then injected into a test horse. Two control horses were injected with mixtures of normal horse serum and virus held for 48 hours. The controls developed symptoms of the disease in 16 and 18 days, respectively. The test horse showed symptoms in 13 days. At the height of the reaction, the test animal received 200 cc. of the hyperimmune serum, which resulted in recovery. No further symptoms were shown by this animal for three years.

From the results of these studies the Russian investigators concluded that the hyperimmune serum used in the experiments contained specific virus-killing antibodies.

Purpose of Investigation

During studies by the present authors on different aspects of equine infectious anemia, the blood of two experimentally induced carrier cases was found to be no longer infectious when injected in large doses into susceptible horses six and seven years, respectively, after the original infection. Both of these horses were likewise resistant when injected subcutaneously with large amounts of the virus. It was, therefore, believed that serum obtained from these two carriers might contain specific antibodies against the virus. Consequently, experiments were carried out to determine what neutralizing effect, if any, such serum might have on the virus obtained from active cases of the disease.

Horses Used and Methods of Handling

The susceptible horses used in these experiments weighed from 900 to 1,400 pounds and were held under observation in screened isolated stables provided with concrete floors and screened vestibules. As far as can be determined, none of the normal horses had any previous contact with horses affected with infectious anemia. Temperatures of all test animals were recorded at least twice daily. Precautions were taken to exclude all possibilities of accidental transmission.

Source of Virus

The virus used consisted of virulent serum obtained from animals experimentally infected with the Wyoming or New Hampshire strain

*Pathological Division, Bureau of Animal Industry, Agricultural Research Administration, U. S. Department of Agriculture, Washington, D. C.

of virus. The Wyoming strain was highly virulent; the New Hampshire strain, moderately so.

Although a specific m.l.d. has not been definitely established for the virus of equine infectious anemia, a number of investigators have reported that, in very high dilution, it is infectious for susceptible horses. Owing to a scarcity of normal horses, the authors were unable to make titration tests on the two strains of virus used in these experiments. However, in a previous experiment[8, 9] titration studies with the Wyoming strain were made a short time after its isolation. It was found that 1 cc. of filtered virulent serum, when administered subcutaneously, intradermically, intravenously or intracranially, produced an acute type of the disease after a short incubation period. The same material, when injected subcutaneously in 0.1 cc. or 0.001 cc. dose, also produced the disease in the acute form after a somewhat longer time.

Source of Antiserum

The antiserum was obtained from two recovered carriers, horse 1295 and horse 1353.

Horse 1295 was infected with a Wyoming strain of virus in July 1941, and until March 1943 its blood was proved to be continually infectious by subinoculation into 27 susceptible horses. Irregular temperature reactions continued until June 1947, but no further reactions occurred to September 1948. On this date, approximately seven years after the original infection, the blood of this animal was no longer virulent when injected subcutaneously in doses of 50 to 100 cc. into susceptible horses. Futhermore, this horse, when subsequently challenged with large doses of a virulent strain of Wyoming virus, showed no reaction.

Horse 1353 was infected with a California strain of virus in October 1942 and had numerous mild temperature reactions at irregular intervals to June 1947. No further reactions occurred to September 1948, when the blood was found to be no longer infectious by subcutaneous inoculation of 50 cc. into a susceptible animal. Thus, approximately six years after the original infection the blood was no longer virulent. Subsequent attempts to reinfect this animal by exposure to three different strains of virus were also unsuccessful.

Experimental Data

Experiment A: In this experiment, virulent filtered serum (Wyoming strain 1042) was mixed in a ratio of 1 to 2 and 1 to 10 with antiserum collected 50 days previously from

TABLE 1—RESULTS OF NEUTRALIZATION TESTS WITH MIXTURE OF INFECTIOUS ANEMIA VIRUS WYOMING STRAIN 1042* AND ANTISERUM** FROM RECOVERED CARRIER 1295 (MIXTURE HELD AT ROOM TEMPERATURE 30 C. FOR TWO HOURS BEFORE INJECTION.)

Horse No.	Wyoming Virus 1042 cc.	Material Mixed with Virus	Ratio	Date Subcut. Injection	Date Reaction	Results of Tests: Incubation Period (days)	Remarks
1281	2	4 cc. antiserum from carrier 1295	1:2	2-18-49	3-11-49	21	Acute fatal case; died 3-22-49.
1442 (control)	2	4 cc. physiological saline	1:2	2-18-49	3-2-49	12	Subacute case — several febrile reactions; animal destroyed.
1145	2	20 cc. antiserum from carrier 1295	1:10	2-18-49	0	0	No reaction for 144 days but animal promptly developed disease when challenged with Wyoming strain of virus; indicates virus was neutralized†
1411 (control)	2	20 cc. serum from normal horse 1393	1:10	2-18-49	3-3-49	13	Subacute case — several febrile reactions; animal destroyed.

*Filtered virulent serum from an active case.
**Recovered from whole blood collected 12-30-48. (Held under refrigeration at 5 to 10 C. for 50 days.)
†Additional evidence that the virus was neutralized was obtained by subinoculation of normal horse 1109 with 50 cc. of blood from horse 1145 collected 4-15-49. Horse 1109 failed to react for 119 days, but when challenged with Wyoming strain of virus promptly developed symptoms of the disease.

recovered carrier 1295. The mixtures were held at 30 C. for two hours and then injected into normal horses. A mixture of the virus with physiological saline or normal serum in the same proportions was likewise injected into normal horses as controls. The results, which are given in table 1, indicate that in the virus-antiserum mixture in the ratio of 1 to 10, the virus was neutralized, whereas in the virus-antiserum mixture in the ratio of 1 to 2 the virus was modified so that the incubation period was prolonged but its virulence was not destroyed as its injection into a susceptible horse resulted in death of the animal.

Experiment B: In this experiment *in vitro* neutralization tests were carried out with two viruses and two antisera. All mixtures were in virus-antiserum ratios of 1 to 10, and were held three hours at 30 C. before being injected into test horses. The results, which are given in table 2, indicate that the antiserum from horse 1295, collected 106 days before being used in tests, neutralized New Hampshire virus 1401 (a strain of medium viru-

TABLE 2—RESULTS OF NEUTRALIZATION TESTS WITH INFECTIOUS ANEMIA VIRUSES WYOMING 1442* AND NEW HAMPSHIRE 1401* AND ANTISERA FROM RECOVERED CARRIERS 1295[1] AND 1353[2] (MIXTURE OF VIRUS AND SERUM HELD AT ROOM TEMPERATURE 30 C. FOR THREE HOURS BEFORE INJECTION.)

Horse No.	Virus Strain	Virus Amt. (cc.)	Material Mixed with Virus	Ratio	Date Subcut. Injection	Results of Tests: Date Reaction	Results of Tests: Incubation Period (Days)	Remarks
1445	1442 Wyo.	5	50 cc. antiserum from carrier 1295; collected 12-30-48	1:10	4-15-49	4-27-49	12	Acute fatal case; died 5-3-49.
1446	1401 N.H.	5	50 cc. antiserum from carrier 1295; collected 12-30-48	1:10	4-15-49	?	?	Questionable reaction; except for temperature of 101.6 F. on 5-15-49 and 103 F. on 6-9-49, the animal remained well to 8-12-49[3].
1444	1442 Wyo.	5	50 cc. antiserum from carrier 1353; collected 4-13-49	1:10	4-15-49	4-27-49	12	Acute fatal case; died 5-10-49.
1447	1401 N.H.	5	"	1:10	4-15-49	5-5-49	20	Subacute case.
1443 (control)	1442 Wyo.	5	50 cc. serum from normal 1393; collected 4-13-49	1:10	4-15-49	5-5-49	20	Acute case.
1448 (control)	1401 N.H.	5	"	1:10	4-15-49	5-5-49	20	Acute case.
1121 (*in vivo* control)	1442 Wyo.	5	50 cc. antiserum from carrier 1295 (not mixed with virus but given by simultaneous injection)	1:10	4-15-49	4-25-49	10	Acute fatal case; died 5-14-49.

*Filtered virulent serum from an active case.
[1] Antiserum held at 5 to 10 C. for 106 days before use in test.
[2] Antiserum held at 5 to 10 C. for two days before use in test.
[3] Evidence that virus was neutralized was obtained when on 8-12-49 this animal was challenged by injection of 50 cc. of N.H. virus from a subacute case and promptly developed an acute fatal case indicating that horse 1446 was not infected.

lency) but failed to neutralize Wyoming virus 1442 (a highly virulent strain). The antiserum from horse 1353, collected two days before being used in tests, failed to neutralize either virus strain. Control tests with mixtures of viruses and normal serum in a ratio of 1 to 10 indicated that both viruses used in the experiment were virulent.

The results obtained with the *in vivo* control used in this experiment when 5 cc. of Wyoming virus 1442 and 50 cc. of antiserum from carrier 1295 were administered simultaneously to a susceptible horse, indicated that the antiserum *in vivo* had no specific action against the virus.

Since antiserum from carrier 1295 had failed to neutralize Wyoming virus *in vitro* when the ratio of virus to antiserum was 1 to 10, which which was not in accordance with results in experiment A (Table 1), it was suspected that a decrease in antibody content of the antiserum had occurred during its 106-day storage period at 5 to 10 C.

The fact that when held at 5 to 10 C. for two days, antiserum from carrier 1353 failed to neutralize *in vitro* either the Wyoming strain of virus 1442 or the New Hampshire strain of virus 1401, suggested that there may be some immunologic difference between these viruses and the California virus. In this connection, cross inoculation tests carried out with the Wyoming and California strains of virus a number of years ago also suggested this possibility.

Experiment C: In this experiment the neutralizing effect of two lots of antisera from carrier 1295 held in storage 134 days and three days, respectively, and antiserum from carrier 1353 held in storage ten days, was tested against Wyoming virus 1442. The virus-antiserum ratio in the mixtures was 1 to 39 and the mixture was held at 30 C. for 24 hours before injection into normal horses. The results given in table 3 indicate that the 134-day-old antisera from carrier 1295 and the ten-day-old antisera from carrier 1353 failed to neu-

TABLE 3—RESULTS OF NEUTRALIZATION TESTS WITH INFECTIOUS ANEMIA VIRUS WYOMING STRAIN 1442[a] AND LOTS A[1] AND B[2] OF ANTISERA FROM CARRIER 1295 AND ANTISERUM FROM CARRIER 1353[3] (MIXTURE OF VIRUS AND SERUM HELD AT ROOM TEMPERATURE 30 C. FOR 24 HOURS BEFORE INJECTION).

Horse No.	Virus Strain	Virus Amt. (cc.)	Material Mixed with Virus	Ratio	Date Subcut. Injection	Date Reaction	Results of Tests: Incubation Period (Days)	Remarks
1451	1442 Wyo.	5	195 cc. Lot A antiserum from carrier 1295; collected 12-30-48	1:39	8-12-49	8-27-49	15	Acute case; several intermittent febrile reactions.
1452	1442 Wyo.	5	195 cc. Lot B antiserum from carrier 1295; collected 8-9-49	1:39	8-12-49	0	0	No reaction for 75 days but promptly developed disease when challenged with Wyo. strain virus 1442; indicates virus was neutralized.
1414	1442 Wyo.	4	156 cc. antiserum from carrier 1353; collected 8-9-49	1:39	8-19-49	9-15-49	27	Subacute case.
1453 (control)	1442 Wyo.	5	195 cc. serum from normal horse 1393; collected 8-9-49	1:39	8-12-49	8-17-49	5	Acute fatal case; died 9-9-49.

[a] Filtered virulent serum from an active case.
[1] Held at 5 to 10 C. for 134 days before use.
[2] Held at 5 to 10 C. for 3 days before use.
[3] Held at 5 to 10 C. for 10 days before use.

tralize the virus. On the other hand, the antiserum from carrier 1295 collected three days prior to the test completely neutralized the virus. These results appear to confirm the findings of experiment B, namely, that storage of antiserum from carrier 1295 for 106 days or longer decreased its specific antibody content and that antiserum from carrier 1353 was either devoid of specific antibodies or possibly different immunologically in some respects from the Wyoming strain of virus.

Summary

Studies indicate that neutralization of the virus of equine infectious anemia by antisera from a recovered carrier originally infected with Wyoming virus occurred when mixtures of virus and antiserum in proportions of 1 to 10 were held two or three hours at 30 C., or when mixtures in proportions of 1 to 39 were held 24 hours at 30 C.

However, with antisera from the same source, neutralization of the virus did not occur when the ratio of the virus-antiserum mixture was 1 to 2, nor did it occur when antisera had been held in storage for long periods before use, indicating a decrease of specific antibody content with age.

The failure to neutralize strains of Wyoming and New Hampshire virus with fresh antisera from a recovered carrier originally infected with California virus suggested the absence of specific antibodies in the serum of the carrier or possibly some immunologic difference in these three strains of virus.

Normal horse serum failed to inhibit the action of the virus when mixtures of such serum and virus in proportions of 1 to 10 or 1 to 39 were injected into susceptible horses.

REFERENCES

1. Havens, L. C. and Mayfield, C. R., Antigenic Properties of the Virus of Rabies: 1. Multiplicity of Strains as Shown by Agglutinin Absorption and Neutralization. *Jour. Inf. Dis.*, 511, 1932.

2. Burnett, F. M. and Galloway, I. A., The Propagation of the Virus of Vesicular Stomatitis in Chorio-Allantoic Membrane of the Developing Hen's Egg. *Brit. Jour. Exp. Path.*, 15:105, 1934.

3. Kernkamp, H. C. H. and Roepke, M. H., The *in vitro* Neutralization of Hog Cholera Virus with Hog Cholera Antiserum. *Am. Jour. Vet. Res.*, 3:300, 1942.

4. Ten Broeck, C. and Merrill, M., Serological Difference Between Eastern and Western Equine Encephalomyelitis Virus. *Proc. Soc. Exp. Biol. and Med.*, 31:217, 1933.

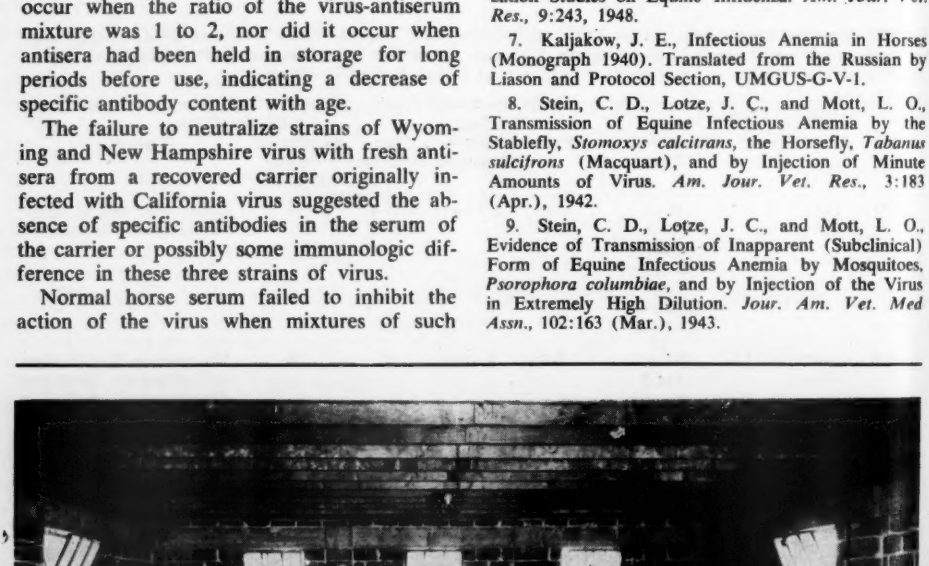
5. Jones, T. C. and Maurer, F. D., Neutralization Studies of the Viruses of Influenza A, Influenza B, and Swine Influenza with Equine Influenza Convalescent Serums. *Am. Jour. Vet. Res.*, 3:179, 1942.

6. Jones, T. C., Gleiser, C. A., Maurer, F. D., Hale, M. W., and Roby, T. O., Transmission and Immunization Studies on Equine Influenza. *Am. Jour. Vet. Res.*, 9:243, 1948.

7. Kaljakow, J. E., Infectious Anemia in Horses (Monograph 1940). Translated from the Russian by Liason and Protocol Section, UMGUS-G-V-1.

8. Stein, C. D., Lotze, J. C., and Mott, L. O., Transmission of Equine Infectious Anemia by the Stablefly, *Stomoxys calcitrans*, the Horsefly, *Tabanus sulcifrons* (Macquart), and by Injection of Minute Amounts of Virus. *Am. Jour. Vet. Res.*, 3:183 (Apr.), 1942.

9. Stein, C. D., Lotze, J. C., and Mott, L. O., Evidence of Transmission of Inapparent (Subclinical) Form of Equine Infectious Anemia by Mosquitoes, *Psorophora columbiae*, and by Injection of the Virus in Extremely High Dilution. *Jour. Am. Vet. Med Assn.*, 102:163 (Mar.), 1943.



Some of the horses at Beltsville used in studies of equine infectious anemia

A Study Of Canine Encephalitis, With Special Reference To Clinical, Bacteriological And Postmortem Findings

R. L. BURKHART, V.M.D.,* G. C. POPPENSIEK, V.M.D.**, and A. ZINK, M.D.***

DURING the past few years, canine encephalitis has become one of the important diseases of dogs although, without a doubt, it has occurred for many years. Dunkin and Laidlaw observed clinically diagnosed canine encephalitis in their original work[1]. Not only are the veterinary practitioners in this country becoming increasingly concerned, but our associates in foreign countries, particularly in England, Scandinavia, and on the European continent, are recognizing it as a commonly occurring problem.

Prevention and treatment can follow only a clear understanding of the etiologic agents, method of transmission, and pathological lesions associated with the disease. MacIntyre and his associates[2] have made outstanding contributions to the knowledge on this subject.

A review of the diseases of the dog, characterized by marked nervous symptoms, indicates that the following disease entities are described:

1. Chorea, sequelae to true distemper
2. Canine encephalitis
3. Hard pad disease
4. Fox encephalitis (associated with infectious canine hepatitis—Rubarth's disease)
5. Postvaccinal paralysis
6. Toxoplasmosis.

Published reports indicate that the pathogenesis of some are more clearly understood than others. The virus etiology of fox encephalitis has been described by Green, *et al.*[3,4], that of canine infectious hepatitis by Rubarth[5], and later pathological studies by Coffin[6]. Recent studies by Seidentopf and Carlson[7] suggest a close antigenic relationship of the causative agents of these diseases. Postvaccinal paralysis in dogs, associated with rabies vaccination, was described by Jervis, Burkhart and Koprowski[8], and others. The reports on the role of Toxoplasma in nervous disease of the dog are few, but the data of MacIntyre[2], and cases in man[9], justify the inclusion of this category.

Chorea, canine encephalitis, and hard pad disease are identified primarily by clinical manifestations. Innes[10], Scherer[11], and others have described the pathological changes within the central nervous system in canine distemper and have concluded that there was little evidence that the changes were due to canine distemper virus. However, Heath[12] has described the variance of distemper virus with evidence of neurotropic tendencies in ferret studies. This would lend support to the belief by Hurst, *et al.*[13], that distemper virus may be the cause of canine encephalitis. A slightly different view is held by Verlinde[14] that a distemper virus type B is the causative agent.

Method of Obtaining Clinical Material

At the outset of this study, it was assumed that there could be a degree of variation in the causative agent of the disease. It was therefore important to obtain cases from widely separated areas. Through the cooperation of eight veterinarians in three states—New York, New Jersey, and Connecticut—22 cases were obtained. The dogs were selected from areas where several cases of encephalitis were occurring with high mortality. At the time the present cases were collected, January through March, 1949, canine encephalitis was clinically diagnosed in 163 dogs in these areas. Each case had a history of acute onset of nervous symptoms, with convulsions, muscular spasm, and incoordination. Table I summarizes the cases obtained, breed and age.

Clinical History

Accurate, detailed data on cases presented to the veterinarian are often difficult to obtain. We were fortunate in this study to secure cases from widely separated kennels where the case histories were relatively complete. The

*Clinical Research, Animal Industry Section, Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.

**At present, Director, Diagnostic Laboratory, New York State Veterinary College, Ithaca, N. Y.

***Department of Bacteriology, Animal Industry Section, Lederle Laboratories Division, American Cyanamid Company, Pearl River, N. Y.

remaining cases add to the data on symptomatology.

The major outbreak occurred in a kennel (A) of purebred Cocker Spaniels. All dogs over two years of age had been vaccinated against canine distemper by the Laidlaw-Dunkin method, and none of these developed symptoms of encephalitis. The remainder consisted of 70 young dogs ranging in age from four to 12 months. Four months prior to the onset of encephalitis, the 70 young dogs exhibited symptoms of clinical distemper and all were treated with sulfonamides plus canine distemper antiserum. All survived but one.

TABLE I—CLINICAL CASES OF CANINE ENCEPHALITIS

Kennel	Case Number	Breed	Age (Months)
A	E-2	Cocker	6½
	E-3	Cocker	11
	E-5	Cocker	4
	E-9	Cocker	6
	E-10	Cocker	6
	E-11	Cocker	8
	E-12	Cocker	8
	E-13	Cocker	6
B	E-18	Collie	5
	E-19	Mongrel	4
	E-20	German Shep.	5
C	E-23	Cocker	1
	E-24	Cocker	1
	E-25	Cocker	1
	E-26	Cocker	36
Scattered Cases	E-1	Mongrel	4
	E-6	Shepherd	8
	E-7	Cocker	12
	E-8	Cocker	4
	E-16	Schnauzer	4
	E-21	German Shep.	4
	E-22	Mongrel	6

The outbreak of encephalitis occurred suddenly in December in one dog, involved four in February, and finally, the remainder in late February and early March. Of the total of 70 young dogs, only ten survived at the termination of the three-month outbreak, giving a mortality of 85%.

The course of the disease in kennel A followed definite patterns:

I. Prenervous symptoms without developing nervous symptoms, followed by complete recovery.

II. Prenervous symptoms without developing nervous symptoms, followed by death.

III. Prenervous symptoms followed by nervous symptoms, resulting in death.

IV. Onset with nervous symptoms only, resulting in death.

Pattern I: The onset was characterized by conjunctivitis with purulent discharge, hemorrhagic ulcerative stomatitis, a slightly elevated temperature, and inactivity. Marked clinical improvement was noted by regression of symptoms in 24 to 48 hours, with recovery evident in four to seven days.

Pattern II: The onset was characterized by anorexia, elevated temperature, conjunctivitis with purulent discharge, ulcerative stomatitis, cough, inactivity, nasal discharge, and vomiting. The temperature fluctuated between 103 F. and 104 F. for ten days. There was clinical improvement of conjunctivitis, but the cough persisted and loss of weight was evident. In one dog the leg reflexes were diminished by the fifth day of illness. Death occurred in eight to 18 days.

Pattern III: The onset was characterized by inactivity, slightly elevated temperature, 103 F., ulcerative stomatitis, and conjunctivitis with purulent exudate. The slightly elevated temperature persisted for ten days or more. From the third to the seventh day of illness, convulsions were noted as described under pattern IV. Periodic convulsions persisted from one to 13 days. Death occurred in seven to 30 days.

Pattern IV: The onset was characterized only by periodic, marked convulsions, sudden immobility, generalized muscular spasm, vigorous "chomping of the jaws" with salivation, followed by prostration and opisthotonos, lasting up to three minutes. At the conclusion of the convulsion, the dog would rise and walk with incoordination, often bumping into objects, for a period of 30 minutes before normalcy was regained. Of six dogs noted, the period from first convulsion to death varied from one to 13 days.

The cases obtained from kennel B, a total of three, were four to five months of age, and all had a history of encephalitis similar to pattern IV of kennel A, with the exception that the duration of the convulsive stage was relatively short, being two to three days from onset to death. No treatment was administered.

Kennel C was unusual in that the four cases consisted of a purebred Cocker Spaniel bitch, three years of age, and her three pups, three weeks of age. The bitch had been vaccinated against canine distemper at the age of five to six months. Two weeks prior to whelping, the bitch was shown at a dog show. Following whelping, the pups developed slowly and at three weeks all became sick, exhibiting convulsions and slightly elevated temperatures as the only symptoms (pattern IV). In two days, euthanasia was necessary. Seven days later, the bitch had a convulsion and then was

asymptomatic for ten days. At this point, a purulent nasal discharge appeared and several convulsions occurred. Treatment included the early administration of canine distemper antiserum, fox encephalitis antiserum, aureomycin, and barbiturates. No treatment had any marked effect on the course of the disease. Euthanasia was performed five days after the last convulsion.

The remaining cases were obtained from several areas and are presented in table II.

TABLE II—SUMMARY OF CLINICAL HISTORY ON SCATTERED CASES.

Case No.	Breed	Age (months)	Disease Pattern*	Duration Prenervous Symptoms (days)	Duration Neurological Symptoms (days)
E-1	Mongrel	4	IV	..	2
E-6	Shepherd	8	III	7	7
E-7	Cocker	12	III	7	14
E-8	Cocker	4	IV	..	3
E-16	Schnauzer	14	IV	..	4
E-21	German Shep.	4	IV	..	3
E-22	Mongrel	6	IV	..	3

*See data on kennel A.

Gross Pathology

MacIntyre[2], discussing recent investigations on canine encephalitides, suggests a classification of six groups based on gross pathology, histopathology, and animal transmission studies. Under group 1b, he describes the following gross pathology: watery purulent catarrh, enlarged tonsils, enlarged cervical lymph glands, inflammation of the duodenum, thickening and hardening of the foot pads, pulmonary congestion, congestion of spleen and liver, and hemorrhagic cystitis.

The gross pathology findings in the 22 cases described in this report, agree in part with this description and may be summarized as follows:

Generally, condition was good, although a few animals were thin, and, in one case, the muscular tissues were pale. A watery or purulent eye and nasal discharge was evident in a few. There was no evidence of hardening or thickening of the pads of any of the dogs examined.

Oral cavity: A common finding was ulcerative stomatitis. In some cases it was quite extensive, particularly in the area of the lower premolars and molars.

Brain: The vessels of the meninges were congested and, in some, hemorrhages were evident.

Lung: Acute congestion was the common finding. Occasionally lobular consolidation and accumulation of exudate in the bronchi were observed.

Trachea: In a few cases, the mucosa of the larynx and trachea exhibited many petechial hemorrhages.

Heart: No common lesions occurred, although few petechial hemorrhages of the epicardium and endocardium, especially in the left ventricle, were present in some. One exhibited white streaks which were evident on cut section extending from the endocardium into the myocardium.

Liver: There were no commonly occurring lesions. In some, there was a mottled surface.

Gastrointestinal tract: The cases examined were remarkably free of internal parasites. A light infestation with Ascaris was noted in one and a heavy infestation with Trichuris in another. Hemorrhagic enteritis was a common finding and varied from a few petechial hemorrhages in the small intestine to marked ecchymotic hemorrhages extending from the small intestine into the posterior bowel. A light hemorrhagic gastritis was observed in only one case.

Kidney: Moderate streaked hemorrhages were frequent in the medullary and cortical portions. In two cases, subcapsular pinpoint white foci were numerous, while in another, only subcapsular petechial hemorrhages were observed.

Urinary bladder: In only one case were petechial hemorrhages of the mucosa observed.

Lymphatics: In a few of the cases, the submaxillary lymph nodes were moderately enlarged.

Thus, the only constant findings were: (1) meningeal congestion; (2) acute congestion of the lungs; (3) hemorrhagic enteritis; (4) ulcerative stomatitis. Due to the variability of the pathology, confirmation of these findings should be made in a greater number of dogs.

Bacteriology

At the outset of these studies, it was decided that bacteriologic examination of the following freshly harvested tissues, from as many cases as possible, was indicated; brain, lymph nodes (mesenteric and cervical), heart, lung, liver, spleen, and kidney. Standard bacteriological laboratory methods were followed in handling these tissues. Each tissue was streaked on 3% sheep blood agar. Also, a 10% tissue suspension was made up of equal parts of each of the above tissues in the cases indicated in table III. A sample of each suspension was injected intraperitoneally into two normal Swiss mice which were observed

daily for a period of ten days. The heart, liver, and spleen of mice dying within this period were cultured.

Table III summarizes the data obtained on the bacteriological examination of tissue samples taken. No single pathogenic organism, with the exception of Proteus, occurred in more than two cases. Thus, a bacterial cause has not been demonstrated. However, it seems reasonable, as with other diseases, that bacteria do contribute to the pathological picture.

Isolation and Identification of Virus

A detailed report of the animal transmission has been published as a separate paper[15] and here only a summary of the data will be included. This phase of the study was completed through the following stages:

TABLE III—A SUMMARY OF THE BACTERIOLOGICAL EXAMINATION OF TISSUES OBTAINED FROM DOGS IN THE ADVANCED STAGES OF ENCEPHALITIS.

Case	Culture	Mouse Susceptibility*
E-3	Blood—*Pasteurella multocida*	.....
E-4	Kidney—hemolytic staphylococcus *Escherichia coli* Lung—*Staphylococcus aureus*	.....
E-6	All tissues—hemolytic streptococcus Pseudomonas *P. multocida*	Died within 24 hours. *P. multocida* isolated from heart blood
E-7	No growth from any organs except lung—*P. multocida*	Died within 24 hours. *P. multocida* isolated from heart blood.
E-8	No growth	.....
E-10	Brain and lung—Corynebacterium Proteus	.....
E-11	Lung and kidney—Proteus and Pseudomonas	.....
E-12	No growth	.....
E-13	No growth	.....
E-14	All tissues—Proteus	1 died in 10 days—recovered Proteus.
E-15	All tissues—*E. freundii* Lymph—Nonhemolytic streptococcus	2 mice died in 24 hours. Streptococcus and *E. freundii* isolated.
E-16	Brain and kidney—Proteus	.....
E-17	Lung—Alcaligenes Kidney and lymph—Beta hemolytic Streptococcus	.....
E-21	All tissues—Alcaligenes	.....
E-22	All tissues—*Salmonella typhimurium*	2 mice died. Recovered *S. typhimurium.*
E-23	Negative	.....
E-24	Negative	.....

*Recorded only when deaths occurred during observation period.

1. Bacteriologically sterile suspensions of tissues from four dogs with encephalitis were transferred to distemper-susceptible ferrets. They developed clinical distemper, but the duration of the disease in ferrets extended to 18 days which is longer than commonly observed, *i.e.*, eight to 12 days.

2. Serial passage of the virus through ferrets shortened the disease course to the expected period of distemper in ferrets of eight to 12 days.

3. Transfer of the virus to distemper-susceptible puppies produced an acutely fatal disease with only nervous symptoms.

4. A cross immunization test showed that ferrets immune to a challenge inoculation with distemper, or the virus of Carré, were also immune to the virus isolated from cases of canine encephalitis.

Since the bacteria-free suspension of tissues from cases of canine encephalitis was infectious, it may be assumed that the agent isolated is of a viral nature. The above findings indicate a closer relationship between the causative agents of distemper and canine encephalitis.

Histopathological Examination of Tissues

Since the detail of this data has been presented in a separate report[15] only a brief summary will be included here.

Although sections of liver, spleen, and kidney of the 22 canine encephalitis cases were prepared, the tissues examined were primarily of the central nervous system. The pathological changes of the central nervous system were uniform in type and distribution. Irregular demyelination of the cerebellum and adjacent areas, with relative spacing of axis-cylinders, proliferation of atypical neuroglia containing inclusions, formation of giant multinucleated cells, and scantiness of perivascular infiltrations were characteristic features. It appeared that degeneration of the myelin was the earliest change brought about by the infectious agent, the incomplete glia reaction being secondary to demyelination.

The brain and cords of ferrets and pups succumbing to inoculation of serially passed virus were also sectioned. In ferrets, no lesions of encephalitis were found, while in one pup the lesions of the brain were similar to those described on the original cases.

Discussion

In this study, we have presented data collected during the course of investigating several widely scattered outbreaks of clinically diag-

nosed cases of canine encephalitis. In all instances, the veterinarians concerned diagnosed their cases as canine encephalitis.

The clinical histories varied, but, on the basis of symptoms and duration of the disease, all could be segregated according to four distinct patterns. Once nervous manifestations developed, the course of the disease was constant, and invariably resulted in death. Survival of a few dogs following nervous symptoms has been reported by some veterinarians. As in other diseases, it may be postulated that age, breed, disease history, and degree of intercurrent infections may change the course of the disease.

The bacteriological findings were essentially negative. However, the presence of some pathogens, *i.e., Pasteurella multocida,* in the tissues, suggests secondary bacterial invasion. From the organisms isolated and the relatively few non-nervous symptoms observed, it would seem that secondary bacterial invaders do not play as important a role as in canine distemper.

The gross pathology of the present cases failed to establish characteristic organic or tissue changes of diagnostic importance. Nevertheless, the extent of pathological changes found in the series of animals is described.

The histopathological lesions of the central nervous system were remarkably uniform in type and distribution. Irregular demyelination of the cerebellum was one of the outstanding changes. Ferrets inoculated with tissue from encephalitis dogs failed to show central nervous pathology, but the infectious agent did cause demyelination in one inoculated pup. This was particularly interesting because, up to this time, only Cheever and his associates[16], working with mice, were able to demonstrate primary demyelination caused by a virus. Several investigators, Pugh[17], Posrednick[15], Marinesco and his associates[10], and King and Meehan[20], have described demyelination as a histopathological finding in cases of canine encephalitis. However, efforts to isolate a causative agent were, in the main, not successful, or were not carried to completion. Close agreement with the present paper is seen in the report by Hurst, *et al.*[18], who described lesions in cases of canine encephalitis similar to those in the present report and were able to produce histopathological lesions in inoculated dogs and one ferret.

The passage of a virus from clinical cases of canine encephalitis to ferrets, with the development of clinical distemper, and the final passage to pups, with the development of only neurological symptoms, suggest a close relationship between "true" distemper (virus of Carré) and canine encephalitis. These findings are in close agreement with Hurst and his associates[18], but differ from the reports of MacIntyre, *et al.*[2], who are of the opinion that the causative agent is a separate entity, characterized not only by nervous symptoms, but by the development of hyperkeratosis of the foot pads and occasionally the nose. In the present report, there was no evidence of hyperkeratosis in any of the 22 cases, nor was it reported by any of the cooperating veterinarians. However, it has been observed by Uvarov (discussion[17]) that the development of hard pads may be only slight, and it may follow that hyperkeratosis is not always a constant finding. Cabasso[21], working with serially passed virus, originating from the present series of canine encephalitis cases, observed hyperkeratosis of the foot pads of inoculated ferrets and one dog. This fact lends support to the ideas that the original viral agent is similar to that of MacIntyre, *et al.*[2], but was not fully characterized until several animal passages were completed.

An argument which may be posed against the distemper etiology in the present outbreaks is that some of the dogs which succumbed to encephalitis had been vaccinated against distemper. However, as indicated by Edwards[22], vaccination against distemper may fail to induce immunity, or the resistance against the enterotropic form may not parallel that against the neurotropic form of distemper. Bateman[23] and Welsh[24], also found that dogs which failed to show reaction to distemper vaccination subsequently contracted a disease which was diagnosed as hard pad disease. However, both authors feel that hard pad disease is only an extension of epidermal changes associated with distemper[23], or that it is a "suppressed form" of distemper[24]. Whatever the true interpretation may be regarding the nature of the distemper and so-called hard pad viruses, one observation in our study should be emphasized. Ferrets vaccinated with the egg-adapted strain of distemper virus derived from a strain which produced "classical" distemper in dogs[25], were equally resistant to challenge with both the virulent strain of distemper virus and with the four strains isolated from the canine encephalitis cases in this study.

In the foregoing discussion, reference is made to the work of others on the disease, canine encephalitis. The differences of opinion are barely mentioned here but are discussed at length in an excellent review by Innes[10]. It is felt that the accumulation of additional data on

all phases of this subject, especially pathology and virology, is greatly needed.

Summary

Twenty-two cases of clinically diagnosed canine encephalitis were studied. In this report, only clinical history, bacteriology and gross pathology are described in detail. Reference is made to the work on virology and histopathology reported by Koprowski and his associates[15]. The following may be stated as salient points:

1. The clinical histories fall into four distinct patterns. The disease seems to predominate in dogs up to one year of age.

2. Bacterial isolates could only be considered to be of secondary importance.

3. The data on gross pathology were not diagnostically significant.

4. A virus was isolated which could not be differentiated from distemper in ferrets, and only caused neurological symptoms in pups.

5. Irregular demyelination of the central nervous system was the predominant histopathologic feature.

REFERENCES

1. Dunkin, G. W., and Laidlaw, P. P., Studies in Dog Distemper. I. Dog Distemper in the Ferret. *Jour. Comp. Pathol. and Therap.*, 39:201 (Sept.), 1926.

2. MacIntyre, A. B., Trevan, D. J., and Montgomerie, R. F., Observations on Canine Encephalitis. *Vet. Rec.*, 60:635 (Dec. 4), 1948.

3. Green, R. G., Katter, M. S., Shillinger, J. E., and Hanson, K. B., Epizootic Fox Encephalitis. IV. The Intranuclear Inclusions. *Am. Jour. Hyg.*, 18:462, (Sept.), 1933.

4. Green, R. G., Ziegler, N. R., and Carlson, W. E., Epizootic Fox Encephalitis. V. General and Pathogenic Properties of the Virus. *Am. Jour. Hyg.*, 19:343 (Mar.), 1934.

5. Rubarth, S., An Acute Virus Disease with Liver Lesions in Dogs (Hepatitis Contagiosa Canis). *Acta. Path. et Microbiol. Skand.*, Supplement 69:1, 1947.

6. Coffin, D. L., The Pathology of So-called Acute Tonsillitis of Dogs in Relation to Contagious Canine Hepatitis (Rubarth). A report of five cases. *Jour. Am. Vet. Med. Assn.*, 112:355 (May), 1948.

7. Seidentopf, H. A., and Carlson, W. E., A Comparative Study of the Fox Encephalitis Virus and the Virus of Infectious Canine Hepatitis. *Jour. Am. Vet. Med. Assn.*, 115:109 (Aug.), 1949.

8. Jervis, G. A., Burkhart, R. L., and Koprowski, H., Demyelinating Encephalomyelitis in the Dog Associated with Antirabies Vaccination. *Am. Jour. Hyg.*, 50:14 (July), 1949.

8a. Burkhart, R. L., Jervis, George A., and Koprowski, Hilary, Postvaccinal Paralysis and Demyelination in the Dog Following Antirabies Vaccination. *Vet. Med.*, 45:31 (Jan.), 1950.

9. Callahan, W. P., Russell, W. O., and Smith, M. G., Human Toxoplasmosis. *Medicine*, 25:343 (Dec.), 1946.

10. Innes, J. R. M., Demyelinating Diseases of Animals. Part II. The Relation of Distemper Infection to the Etiology of Canine Encephalopathies. *Vet. Med.*, 44:421 (Oct.), and 467 (Nov.), 1949.

11. Scherer, H. J., Vergleichende Pathologie des Nervensystems der Saügtiere. *Springer Verlag, Leipzig*, 1944.

12. Heath, L. M., Distemper Studies. *Canad. Jour. Comp. Med.*, 4:352 (Dec.), 1940.

13. Hurst, E. W., Cooke, B. T., and Melvin P., Nervous Distemper in Dogs. *Australian Jour. Exp. Biol. and Med. Sci.*, 21:115 (June), 1943.

14. Verlinde, J. D., Opmerkingen over de Vormen van Encephalitis bij de Hond. *Tijdschr. v. Dirgeneesk.*, 23:922, 1948.

15. Koprowski, H., Jervis, G. A., James, T. R., Burkhart, R. L., and Poppensiek, G. C., A Study of Canine Encephalitis. *Am. Jour. Hyg.*, in press.

16. Cheever, F. S., Daniels, J. B., Pappenheimer, A. M., and Bailey, O. T., A Murine Virus (JHM) Causing Disseminated Encephalomyelitis with Extensive Destruction of Myelin. I. Isolation and Biological Properties of the Virus. *Jour. Exp. Med.*, 90:181 (Sept. 1), 1949.

17. Pugh, L. P., So-Called "Hard Pad" Disease. *Vet. Rec.*, 61:363 (June 25), 1949.

18. Posrednick, F. I., Histologische Untersuchungen des Zentralnervensystems bei Hundestaupe. *Ztschr. f. Infektionsk. d. Haustiere*, 38:135, 1930.

19. Marinesco, G., Draganesco, S., and Stroesco, G., Recherches Histopathologiques sur la Maladie des Jeunes Chiens (Maladie de Carré). *Ann. Inst. Pasteur*, 51:215 (Aug.), 1933.

20. King, L. S., and Meehan, M., Symposium—Multiple Sclerosis. New York American Society Nervous and Mental Disorders, 1949.

21. Cabasso, V. To be published.

22. Edwards, J. T., (Discussion) Distemper and Hard Pad Disease in Dogs. Central Veterinary Society Discussion. *Vet. Rec.*, 61:175 (Apr. 2), 1949.

23. Bateman, J. K., Recent Experiences in Post-Inoculation Behavior in the Greyhound, Following the Use of Field Distemper Method I, Anti-Vaccination. *Vet. Rec.*, 61:278 (May 21), 1949.

24. Welsh, W. C., This So-called "Hard Pad" Disease. *Vet. Rec.*, 61:315 (May 28), 1949.

25. Cabasso, V., and Cox, H. R., Propagation of Canine Distemper Virus on the Chorio-Allantoic Membrane of Embryonated Hen Eggs. *Proc. Soc. Exp. Biol. and Med.*, 71:246 (June), 1949.

▼ ▼ ▼

Veterinary Clinics for Large Animals

Privately operated clinics, established in rural centers of livestock production, are seen as a coming development in farm animal care.

Such clinics would give livestock owners the maximum benefits of modern veterinary medicine and surgery, according to Dr. W. M. Coffee of LaCenter, Ky., president-elect of the American Veterinary Medical Association.

Experience has shown that the fully equipped clinic, staffed by two or more veterinarians, is advantageous to all concerned because it permits certain types of treatment and special technic that are sometimes difficult to use on the farm.

Under this plan, owners usually bring their animals to the clinic in trailers or other conveyances.

Pseudostertagia Bullosa (Ransom And Hall, 1912) Orlov, 1933, From New Mexico Sheep, With A Note On The Gubernaculum*

O. WILFORD OLSEN, A.B., A.M., Ph.D., Fort Collins, Colorado

THE trichostrongylin stomach worm *Pseudostertagia bullosa* (Ransom and Hall, 1912) Orlov, 1933 was described from sheep originating in Colorado and Montana[4].

According to Lucker and Dikmans[3], this nematode had not been reported from sheep in the 32 years intervening between the original description and the publication of their paper. The second report of its occurrence was made by these workers[3] from specimens obtained from two lambs in western South Dakota.

In the present paper there is given (1) an additional report, which is the third, on the occurrence of *P. bullosa* in sheep, (2) an extension of its range into the southwestern United States, and (3) additional information on the morphology of the gubernaculum whose shape is rather unusual.

P. bullosa was found in a lot of 1363 sheep shipped from Thoreau, McKinley County, and Farmington, San Juan County, New Mexico, to Colorado A. & M. College where they were used in a feeding experiment during the winter of 1948-1949. Of the animals that died during the course of the experiment, nine were examined for parasites, four of which were infected with *P. bullosa*. The number of worms recovered from each sheep was one, 23, 31, and 67. It was not possible to ascertain from which of the two localities the infected sheep originated.

Comparison of the specimens of *P. bullosa* from New Mexico sheep with the original material of Ransom and Hall from Colorado, loaned from the United States National Museum, showed them to be the same species.

The present known range of *P. bullosa* includes the states of Montana[2,3], South Dakota[3], Colorado[4], and New Mexico.

There was no evidence that this parasite is pathogenic for sheep. Deaths were due to causes other than parasitism.

In addition to sheep, Lucker and Dikmans[3] reported *P. bullosa* from wild antelope killed in South Dakota and Montana. On the basis of the large number of parasites (estimated 810) collected from one antelope, these authors suggested that this stomach worm might be normally a parasite of antelope, which may account for its known limited occurrence in sheep.

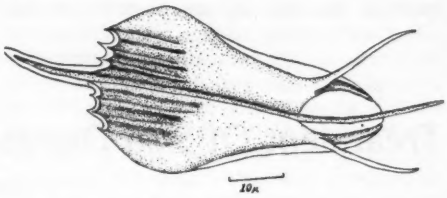


Fig. 1—*Pseudostertagia bullosa*, the trichostrongylin stomach worm described from sheep.

Although antelope had disappeared entirely from the northwest corner of New Mexico by 1883[2], introductions of them began in 1937[1]. At the present time, a number of small bands have been established in that section of the state, some of which occur in the general region where the sheep originated[1]. If the assumption of Lucker and Dikmans[3] that antelope may be the natural host is correct, the conditions for establishment of this parasite in the sheep of that region appear to have been satisfied.

Studies made on living male worms showed features of the gubernaculum not mentioned in the original description which are believed to be significant and worthy of record.

Ransom and Hall[4] described the gubernaculum as "irregularly trihedral in shape, somewhat resembling a plowshare in outline when viewed from the side, and prolonged into a process anteriorly."

When viewed from the dorsal surface under pressure, the general outline of the gubernaculum in our specimens is roughly shield-shaped, with one long median anterior and five long posterior processes (Fig. 1).

*Contribution from the Zoology Department, Colorado A. & M. College, No. 5.

The anterior process, which is about one-third the length of the body of the gubernaculum, continues posteriorly along the mid-dorsal line as a distinct ridge, extending caudad to form a free posterior process about two-thirds the length of, and more slender than the anterior one. On the anterior margin of the gubernaculum laterad from the median process are three distinct serrations. From each serration there extends caudad for about one-third the length of the gubernaculum, a low costa.

The posterior end of the gubernaculum consists of two sclerotized horn-shaped processes whose tips approach but do not touch the posterior median process. The area enclosed by these horn-shaped processes consists of a hyaline membrane. Arising from near the base of each of the horn-shaped processes is a long, slender, hyaline projection which reaches almost to the end of the posterior median process. A narrow, marginal, hyaline band extends from near the middle of the gubernaculum to the tip of the horn-shaped processes.

The body of the gubernaculum is about 63 microns long, and agrees in size with measurements given by Ransom and Hall[4].

REFERENCES

1. Barker, Elliott S., Personal communications, 1950.

2. Bailey, Vernon, Mammals of New Mexico. North American Fauna No. 53, U. S. Dept. Agr., Bur. Biol. Surv., 1931.

3. Lucker, John T. and Dikmans, G., The Distribution of *Pseudostertagia bullosa* and Some New Nematodes from Pronghorn Antelope (*Antilocapra americana*). *Proc. Helminth. Soc. Wash.*, 12:2, 1945.

4. Ransom, B. H. and Hall, M. C., A New Nematode, *Ostertagia bullosa*, Parasite In the Alimentary Tract of Sheep. *Proc. U. S. Nat. Mus.*, 42(1892):175, 1912.

Treatment Of Skin Diseases With Ichor*

SAMUEL BENDER, D.V.M., Riverdale, New York

RECENTLY a new and markedly different preparation, composed of chlorides of sodium, cerium, calcium, and yttrium (Ichor, Vassar Laboratories, Ltd.), used initially in the treatment of hyperkeratosis, ringworm, and scabies of cattle, was suggested for use in various related skin diseases of dogs and cats.

Personal investigation revealed the successful application of the formula for the treatment of hyperkeratosis (X disease) in cattle. In this disease of unknown origin[1], ichor solution and ointment were used in bringing about recoveries in affected herds in which losses were occurring due to abortion, emaciation and death. Ichor was used externally over the bodies of the affected animals and as an oral spray. Satisfactory relief of symptoms followed treatment. Spraying the mouth of apparently healthy cattle in the herd appeared to check the spread of the disease. This significant prophylactic measure may be the key to success in the control of similar contagions. Prompted by this information, the treatment of several cases of common ringworm and scabies in farm herds was attempted. Results obtained were so satisfactory, that it was deemed advisable to adapt this treatment to small animals.

Ichor is marketed as a solution and ointment to be used simultaneously. It is clear, colorless and odorless in solution, and, in a lanolin ointment base is free of objectionable color or odor. It is a therapeutic agent which offers a departure from all previously established skin preparations.

The action of this medication is based upon the release of chlorine and oxygen. When applied locally, it stimulates tissue respiration and skin health, as well as exerting an inhibitory effect upon the caustive agent responsible for the disease. It has been a particularly valuable preparation in the treatment of many doubtful skin eczemas, dermatoses, and alopecias, while being a specific for fungus and bacterial infections, primary or secondary, and sarcoptic mange.

Before applying this method of treatment, it was necessary to determine whether the formula was poisonous or toxic to small animals. The ointment and liquid were applied in increasing amounts around the mouth and face on dogs and cats. In no case was there any toxic reaction, even though these animals invariably ingested varying amounts of the chemical. The concentrated solution placed directly into the mouths of the experimental animals, caused a profuse salivation, but no further untoward reaction. In half strength, little or

*Ichor supplied by the Vassar Laboratories, Ltd., Inc., 2248 Broadway, New York 24, N. Y.

no salivation took place and was tolerated equally well by cats and dogs. Extended studies corroborated these observations. In testing the effects upon the conjunctiva of the eyes, various concentrations of ichor solution were instilled by dropper upon the eye. It was found to be nonirritating to the mucous membranes of the eye when applied in diluted strength (four parts of water to one part of the solution). The undiluted solution when applied to the eye, will cause a transient conjunctivitis. The ichor ointment when applied on the eyeball proper, causes no ill effect and is well tolerated by the animal. These facts having been established, treatment with ichor would, therefore, not have to be limited to any one animal, nor would it be dangerous to treat lesions around the face and eyes.

Case Reports

The first case chosen for treatment was a four-month-old female cat weighing 3⅓ pounds. This animal was being treated with a fungicidal cream for ringworm involving the face, neck, and shoulders. Response was slow and new areas continued to appear during the treatment. Ichor solution was swabbed into and around the ringworm lesions and ointment applied over the same regions. Treatment was repeated twice daily for three days. Ointment alone was then applied once daily for four days. This animal made a complete recovery and new hair appeared within the margin of the lesions at the end of the treatment period. The cat was hospitalized for three more days and as no new areas developed, it was discharged. Subsequent checks at regular intervals showed no recurrence. Several other cases of ringworm were later treated by the same method, with equal success.

The second case reported was otorrhea affecting a three-month-old Wirehaired Fox Terrier. Only the left ear was involved. The animal was evidently in considerable distress. The external ear canal was filled with a dark brown exudate, which when removed, revealed an intensely inflamed lining. Treatment consisted of swabbing the canal with ichor solution, and then packing the canal with ichor ointment. The owner continued daily treatments at home with ointment alone. The dog was returned to the clinic on the third day, when treatment with solution and ointment was repeated. At this time great improvement was noted. Treatment with ointment was continued at home for an additional three days, then discontinued. Complete resolution was affected. One month later, the right ear became affected and was treated in a similar manner with good results after seven days. No further recurrence has been reported. In a sizable group of infections involving the ear canal recoveries were satisfactory in 85% of the cases. When no improvement is shown after three or four days, other therapy is instituted, *i.e.*, sulfonamides, pellitol, etc. Ichor is, however, a satisfactory treatment in many cases which are resistant to other remedies and many cases of severe otorrhea presented have been brought under control in a short time.

A five-year-old black Cocker Spaniel neuter, was treated for a chronic eczematous dermatitis of several years' duration. In this case, the hair was completely absent along the back and there was an intense pruritus. Sores and scabs were present over the affected areas and also present on the abdomen and inside the thighs. Full strength solution, followed by ointment, was applied. Relief from itching was observed immediately. On the second day inflammatory lesions were subsiding. The skin had lost its dry, scaly characteristics and was becoming soft and pliable. On the fourth day, new hair growth was noted and in ten days an almost new coat of hair had appeared on the back and tail. This was a remarkable recovery in a dog that had been severely affected for over two years and had undergone various types of treatment for summer eczema.

Treatment of the various stages of eczematous dermatoses has demonstrated the ability of the ichor formula to allay itching and thereby prevent further self-mutilation. When left untreated, many animals will actually develop ulcers of the skin and gangrenous areas, due to intense and continual rubbing and licking. Indolent skin ulcers tend to heal and break out at regular intervals. Removing the scab, swabbing with the solution and packing with the ointment, has brought about definite healing and resolution of these ulcerated areas.

A nine-month-old spaniel, cross-breed, male, was presented for treatment of a large patch of moist eczema, approximately two inches in diameter. A typical "hot-spot", the area was denuded of hair and intensely inflamed. The area was cleaned up, the surrounding hair shaved and liquid and ointment applied. The dog was sent home with instructions to the owner to apply the liquid and ointment twice daily, and to return the dog in one week. This he failed to do. However, the dog was brought in for a rabies vaccination two weeks later, and according to the owner, the lesion had

healed very rapidly, and he therefore saw no need to bring the animal in for that particular purpose. At this time it was observed that the area was completely healed and hair growth restored. Moist eczemas respond remarkably well to this treatment. It is well to clip or shave the areas surrounding the apparent lesion, as adjacent new lesions may be developing under the hair coat only to appear suddenly as new patches. With ichor treatment, the spread is checked, the fungus destroyed and the skin health restored in as short a time as could be desired. It appears to be specific for some common fungus infections.

A ten-year-old Sealyham Terrier was brought in for severe chronic inflammatory eczema of the left eyelid. Previous treatment had been unsuccessful. The entire circumference of the eyelid was involved and proliferative tissue had greatly thickened the lids. There was profuse lacrimation and conjunctivitis present. Ichor solution, diluted one part to 20 parts of water, was instilled by dropper into the eye and ointment applied over the affected eyelid. Ointment alone was dispensed for application twice daily, and when examined five days later, healing was strikingly evident. Ten days after treatment was started, the eyelid was perfectly normal, the conjunctiva had cleared, and the denuded areas around the eyes had completely grown in.

A male smooth-haired Fox Terrier, three years of age, suffering from interdigital eczema of the left hind foot, was presented for treatment. Itching was severe and lameness evident. The affected areas between the toes were swabbed with ichor solution, full strength, and then packed with ointment and bandaged. Treatment was repeated in three days and the foot rebandaged. This pack was left in place for three days more and then removed. Healing was complete.

Bandaging the foot has given the best results in treating interdigital eczema with this drug. Care should be taken that the dog does not get the pack wet.

Summary

Ichor solution and ointment offer a unique and extremely reliable remedy for the treatment of the common and many uncommon skin diseases of all animals. The method of using these preparations is new in the field of skin therapy and makes them a valuable adjunct in the treatment of eczemas, dermatoses, fungus and bacterial infections, otorrhea, skin ulcers and sarcoptic mange.

Treatment is essentially simple, depending upon the severity of the lesions present, and the tendency to spread. In all cases the hair is clipped or shaved, the crusts, scabs, and scales removed, and the area generally cleansed. The solution in full strength is applied, by means of a spray or swab, on to and around the affected areas. The ointment is then applied over the same areas. This treatment should be repeated at least once and preferably twice daily for optimum results. When improvement is evident, liquid may be discontinued and ointment alone used daily.

Its ease of application, safety in both dogs and cats, nonirritating properties, the relief it affords from itching, and its remarkable healing and hair-growing properties, merits ichor a place in the armamentarium of every practitioner for the control and treatment of many varieties of skin infections. Since there are no contraindications for this treatment, many new uses for the drug will present themselves to the clinician.

REFERENCES

1. Simpson, Charles F., Hyperkeratosis or X Disease in Florida. *Vet. Med.*, 44:51 (Feb.), 1949.
2. Ensign, David T., personal communication.

▼ ▼ ▼

Effect of Thyroprotein on Swine

The addition of thyroproteins to the basal ration of pigs at levels of 0.0088, 0.0132 and 0.0176%, resulted in a significant increase in rate of growth. Hogs fed thyroprotein required less feed per 100 pounds gain.

In trials conducted by Perry, *et al.*, at Purdue University Agricultural Experiment Station, the feeding of thyroprotein had no effect on carcass composition other than that in a given period it resulted in the production of heavier carcasses which, in turn, differed in composition from the lighter carcasses of control pigs. When adjustment was made for the difference in liveweight of thyroprotein-fed and control groups by use of the regression coefficient there was no significant difference in composition.

When compared on the same age basis, carcasses of hogs receiving thyroprotein had a higher percentage of fat and lower percentages of moisture, protein, and mineral matter than animals receiving no thyroprotein.—*Jour. An. Sci.*, 9:48 (Feb.), 1950.

In Vitro Diffusion Of Penicillin From Penicillin Ointments For Bovine Mastitis

V. P. SEEBERG*, Ph.D. and J. P. STREET*, M.S., Berkeley, California

NUMEROUS reports in veterinary literature indicate a high degree of efficacy for the treatment of bovine *Streptococcus agalactiae* mastitis with penicillin, and consequently it has become the agent of choice in the therapy of this important disease of dairy cattle. Preliminary trials with parenteral administration of penicillin[1, 2] indicated this method of treatment to be impractical because of the high dosage and frequent administration necessary to provide bacteriostatic levels of penicillin in the milk. On the other hand, local administration of a comparatively small dose of penicillin directly into the bovine mammary gland provided bacteriostatic levels of penicillin in the milk for relatively long periods of time[3, 4, 5].

The standard procedure for the earlier treatments was to dissolve the penicillin in a sterile aqueous vehicle (usually distilled water) and to infuse the resulting solution into the infected mammary quarter. Because of the instability of penicillin in contact with water, these solutions had to be prepared by the operator immediately prior to infusion. To eliminate this manipulation in the field, stable ready-to-use dosage forms have been developed, including water soluble bougies[6, 7, 8] and oil suspensions[9, 5, 10]. Our preliminary trials with simple mineral oil suspensions gave results equally as good as water solutions[5], except for the fact that in time, the penicillin powder tended to settle out and cake on the bottom of the container, making it difficult to resuspend. Conversion of the preparation to an ointment was readily accomplished by the addition of 25% or more of various other solid ointment ingredients. This prevented settling of the penicillin, but concern was felt regarding diffusibility of the penicillin from the preparation.

Since lactating animals are milked every 12 hours, efficient practical use of penicillin preparations depends upon complete liberation from the vehicle during that period. Any unliberated penicillin remaining in the vehicle would probably be milked out in the foremilk, and would therefore be wasted. All diffused penicillin is not milked out, as some remains in the residual milk to be diluted by secretion during the following 12-hour period, and effective concentrations of penicillin are still found in the milk even after 24 to 48 hours[6, 9]. There is also evidence of some absorption from the udder into the blood stream[9], and this absorbed penicillin cannot contribute to the local penicillin concentration in the gland. Theoretically, therefore, the most efficient preparation would rapidly release sufficient penicillin to give an effective initial penicillin concentration in the gland, and would release the remainder of the penicillin slowly during the ensuing 12 hours, thus exposing the minimum amount of penicillin to absorption during that period. Diffusion should be complete at the end of 12 hours in order to avoid milking out unreleased penicillin.

It was not practical to test each of our experimental preparations for these properties in the field. Huyck[11] cites evidence to show that the results of *in vitro* tests of diffusibility of medication from ointments has led to the same general conclusions as those which have been reached in clinical studies on the same preparations. The *in vitro* method chosen was essentially one proposed for ointments by Waud and Ramsay[12], with slight modifications.

Method

One gram of the ointment to be tested was applied to the inside surface of a 6 cm. x 1 cm. test tube, using a glass rod to spread the ointment to a uniform layer with a circular motion. Twenty-five cc. of fresh milk were pipetted into the tube, and the tubes were then incubated at 37 C. At hourly intervals, each tube was gently inverted three times to insure uniform diffusion of the penicillin in the milk. Samples for assay were withdrawn at one, four, eight and 12 hours. Assays were performed by the F.D.A. agar plate method[13].

Experimental

Fourteen ointment bases were prepared for testing, using only combinations of base ingredients allowed by the F.D.A. for penicillin ointment[14]. Each ointment was then prepared

*Research Division, Cutter Laboratories.

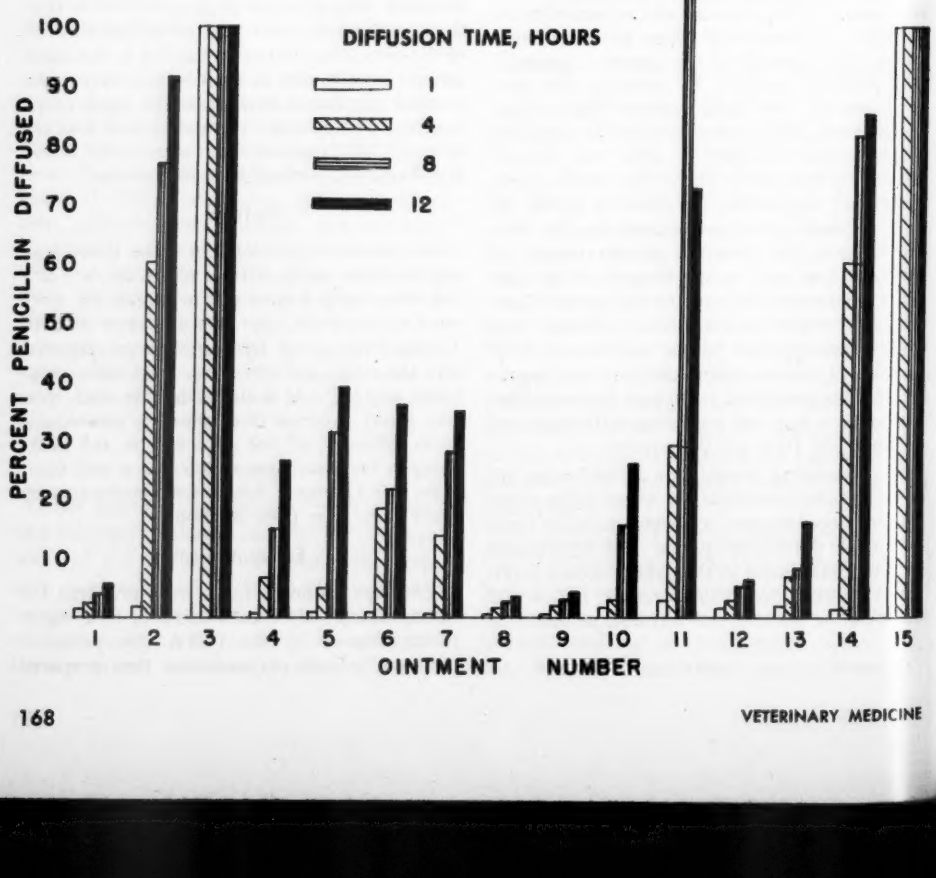
to contain 100,000 units of crystalline potassium penicillin G per gram in the form of a 200 mesh powder. The bases used are listed in table I. The preparations containing 75% oil were semi-liquids and, therefore, did not conform to the usual pharmaceutical concept of ointment consistency, but this property did not affect their usefulness for our particular purpose. Results of the *in vitro* diffusion tests are shown in figure I.

Table 1—Ointment Bases

1.	Liquid petrolatum U.S.P.	25%
	White petrolatum U.S.P.	75%
2.	Liquid petrolatum U.S.P.	50%
	White petrolatum U.S.P.	50%
3.	Liquid petrolatum U.S.P.	75%
	White petrolatum U.S.P.	25%
4.	Liquid petrolatum U.S.P.	25%
	White petrolatum U.S.P.	70%
	Anhydrous lanolin U.S.P.	5%
5.	Liquid petrolatum U.S.P.	25%
	White petrolatum U.S.P.	65%
	Anhydrous lanolin U.S.P.	10%
6.	Liquid petrolatum U.S.P.	25%
	White petrolatum U.S.P.	55%
	Anhydrous lanolin U.S.P.	20%
7.	Liquid petrolatum U.S.P.	25%
	White petrolatum U.S.P.	45%
	Anhydrous lanolin U.S.P.	30%
8.	Liquid petrolatum U.S.P.	25%
	White petrolatum U.S.P.	70%
	White beeswax U.S.P.	5%
9.	Peanut oil U.S.P.	25%
	White petrolatum U.S.P.	75%
10.	Peanut oil U.S.P.	50%
	White petrolatum U.S.P.	50%
11.	Peanut oil U.S.P.	75%
	White petrolatum U.S.P.	25%
12.	Cottonseed oil U.S.P.	25%
	White petrolatum U.S.P.	75%
13.	Cottonseed oil U.S.P.	50%
	White petrolatum U.S.P.	50%
14.	Cottonseed oil U.S.P.	75%
	White petrolatum U.S.P.	25%
15.	Aqueous control	

It may be noted that of the ointments studied, most rapid diffusion was obtained from ointment 3 with 25% white petrolatum and 75% liquid petrolatum as the base, diffusion being complete at the end of one hour.

FIGURE I—DIFFUSION OF PENICILLIN FROM VARIOUS OINTMENT BASES INTO MILK, REPRESENTED AS PERCENT OF TOTAL PENICILLIN DIFFUSED AFTER VARIOUS PERIODS OF TIME.



Diffusion from ointment 2, with equal parts of these same ingredients as the base was considerably less rapid, diffusion being 0.6% complete after one hour, 60% after four hours, 75.0% after eight hours and 91.5% after 12 hours. This rate is probably approaching the theoretical optimum, which was mentioned earlier as being one which reached completion at the end of the 12-hour period. When the white petrolatum concentration was increased to 75% (ointment 1) diffusion was markedly retarded, only 5.0% of the contained penicillin being released in 12 hours.

Ointments 4, 5, 6 and 7, containing various amounts of anhydrous lanolin were modifications of ointment 1. Since lanolin possesses hydrophilic properties, it was incorporated with the hope of possibly speeding up diffusion from this base. Some acceleration was noted when 5% to 10% lanolin was added (ointments 4 and 5) but no further increase in rate was noted by the addition of 20% and 30% (ointments 6 and 7). The addition of 5% white beeswax (ointment 8) resulted in further retardation of diffusion.

Ointments 9, 10, 11 and ointments 12, 13 and 14 were modifications of ointments 1, 2 and 3 with mineral oil replaced by peanut oil and cottonseed oil, respectively. Diffusion in each case was less rapid than in the corresponding ointment containing mineral oil, and in none of the modifications was diffusion complete at the end of 12 hours. The assay result for the eight-hour sample on ointment 11 is obviously in error.

Summary

The diffusion characteristics of an efficient penicillin preparation for the local treatment of bovine mastitis were considered. Three important characteristics appeared to be as follows:

1. Rapid release of sufficient penicillin to give an effective initial penicillin concentration in the gland.

2. Slow release of the remainder of the penicillin during the ensuing 12-hour period.

3. Completion of diffusion at the end of the 12-hour period.

In vitro diffusion studies on 14 penicillin ointments for bovine mastitis treatment indicated diffusion of contained penicillin into milk to be nearest optimum from those with bases composed of mixtures of liquid petrolatum and white petrolatum. The concentration of white petrolatum to use in order to obtain the theoretical optimum diffusion characteristics appeared to be between 25% and 50%. Further increase in the white petrolatum concentration to 75% resulted in insufficient diffusion; only 5.0% of the penicillin contained in the ointment being released during the 12-hour experimental period. Some lessening of this retardation was obtained by the addition of lanolin. On the other hand, the addition of beeswax resulted in even greater retardation of diffusion.

REFERENCES

1. Bryan, C. S., Huffman, C. F. and Harwood, R. E., *Vet. Med.*, 40:87, 1945.
2. Casselberry, N. H. and Seeberg, V. P., unpublished data, 1944.
3. Weirether, F. J., Jasper, D. E. and Petersen, W. E., *Proc. Soc. Exp. Biol. and Med.*, 59:282, 1945.
4. Stevenson, W. G., *Canad. Jour. Comp. Med. and Vet. Sci.*, 10:82, 1946.
5. Schalm, O. W. and Casselberry, N. H., *Jour. Am. Vet. Med. Assn.*, 109:470, 1946.
6. Bryan, C. S., *Vet. Med.*, 41:429, 1946.
7. Barnum, D. A., *Canad. Jour. Comp. Med. and Vet. Sci.*, 11:64, 1947.
8. Horlein, B. F. and Schalm, O. W., *Jour. Am. Vet. Med. Assn.*, 113:43, 1948.
9. Schofield, F. E., *Canad. Jour. Comp. Med. and Vet. Sci.*, 10:63, 1946.
10. Walker, F. E., *Jour. Am. Vet. Med. Assn.*, 108:413, 1946.
11. Huyck, C. L., *Jour. Am. Pharm, Assn.*, 35:129, 1946.
12. Waud, R. A. and Ramsay, A., *Canad. Med. Assn. Jour.*, 48:121, 1943.
13. Federal Register, 12:(67):2215, (April 4), 1947, ss. 141.1.
14. Federal Register, 13:(252):8386, (Dec. 28), 1948, ss. 146.26.

▼ ▼ ▼

Noted Research Worker Dies

Dr. George C. Supplee, outstanding biological and food chemist, died of a heart attack at his home, Bainbridge, N. Y., November 7, 1949.

Doctor Supplee's entire professional career was devoted to research, mainly in the employ of the Borden Company, and later in his own laboratory and consulting service. He developed the first commercially practical method for irradiating milk and methods for the commercial production of riboflavin from waste milk products, for which he received the Billings award from the American Medical Association (1936). For research in the chemistry of milk, he received the Borden award of the Chemical Society. He published more than 100 scientific papers on his research work.

Dr. Supplee was coauthor of a series of 12 articles on Canine Pediatrics which were published in this magazine in 1937 and 1938. He and his assistant, Mr. J. H. Le Ware, conducted the extensive nutritional and clinical research upon which this series of articles was based.

The Prophylaxis And Therapy Of Hepatic Coccidiosis In The Rabbit By The Administration Of Sulfonamides*

E. H. PETERSON, D.V.M., Ph.D., Pullman, Washington

THE great volume of data available on the activity of the sulfonamides in the control of coccidiosis in domestic birds and other farm animals, particularly sheep, lead one to suspect that these chemotherapeutic agents may be effective generally against all coccidial parasites. Relatively little data are available regarding the effectiveness of sulfonamides against coccidiosis in the rabbit. Jankiewicz[1] first reported the daily ingestion of 0.625 gm. of sulfasuxidine, for 13 days by young rabbits, to be prophylactic against hepatic coccidiosis due to *Eimeria stiedae*. Horton-Smith[2] found 1% sulfamethazine in the feed to be effective against hepatic coccidiosis when drug administration was initiated at any time previous to ten days after artificial infection. Treatment begun at the fifteenth day was of no avail. The drug was found to be active also when administered as 0.5% of the feed. Chapman[3] found 0.05% sulfaquinoxaline in the water to exert prophylactic activity against this parasitic condition.

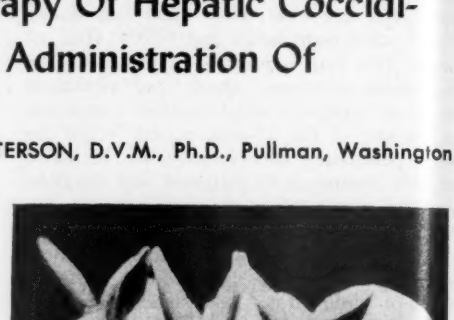
These studies were undertaken to study quantitatively the activity of some of the sulfonamides against hepatic coccidiosis in the rabbit due to *E. stiedae*.

Methods

Young rabbits, reared continuously upon wire, were used for the trials. An arbitrary inoculum of sporulated oocysts was administered to each test animal by means of a stomach tube. The medicant in all cases was dissolved in the drinking water. The rabbits had access to no other water during the course of the respective trials. Results were evaluated by noting mortalities, observing the condition of the liver upon postmortem examination, and making microscopic search for oocysts. Two drugs, sulfaquinoxaline and sulfamerazine, were selected for the detailed trials.

Results

The first objective was to determine the minimum concentration of the test drug which, when administered in the water continuously from the time of infection to the termination of the trial, would inhibit completely the development of lesions due to *E. stiedae*. Animals were sacrificed 21 days after infection. Each test rabbit was exposed to infection with 500,000 sporulated oocysts.



Sulfaquinoxaline was tested at concentrations varying from 0.00125 to 0.025%, and sulfamerazine from 0.0025 to 0.05%. A total of 46 rabbits were used in these trials that extended over a period of several months. Without detailing the data, the administration of either drug as 0.02% of the drinking water was sufficient to exert maximum prophylactic activity against the development of hepatic coccidiosis, as judged by the complete absence of gross lesions and of demonstrable oocysts in the hepatic tissue of animals sacrificed three weeks after infection. The trials were adequately controlled. The administration of either drug at concentrations below 0.02% in the water gave inconsistent results.

The second objective was to determine the minimum length of the medication period necessary for maximum prophylactic or therapeutic effect. Rabbits were exposed to infection as before and medicated for varying periods of time beginning at the time of infection, or after intervals of ten or 30 days. Results are presented in table 1.

Medication for five days only, beginning

*Published as Scientific Paper No. 895, Washington Agricultural Experiment Stations, Institute of Agricultural Sciences, State College of Washington, Pullman.

simultaneously with or ten days after infection, is shown to be ineffective prophylactically or therapeutically against the disease (rabbits 1, 2; 11, 12). Medication for ten days was of substantial benefit in individual rabbits, but results were not consistent. Complete prophylaxis was attained in the case of rabbits 3, 4 and 19, where medication was initiated at the time of infection. Partial prophylaxis only was achieved with rabbit 18. When the onset of medication was delayed ten days (rabbits 13, 14), medication with sulfaquinoxaline was of benefit, but not 100% effective. Rabbits 22 and 23, medicated with 0.025% sulfamerazine for ten days beginning ten days after infection, were not materially benefited.

All rabbits medicated for 15 days were benefited by the treatment. In the case of rabbits 7 and 21, medicated 15 days beginning at 0 day, complete prophylaxis was achieved. Only partial success was obtained in the case of corresponding rabbits 5, 6 and 20. Complete therapeutic effect was apparently secured in the case of rabbits 15, 24 and 25, medicated for 15 days beginning at the tenth day after infection. Medication was of value in the case of rabbits 27 and 28, medicated for 15 days beginning 30 days after infection. There is doubt, however, as to whether or not the infection was eliminated from the liver. The few oocysts present may have originated from still active but suppressed lesions, or they may have been residues retained from the pre-medication period. Treatment for 20 or more days gave consistently good results (rabbits 8, 9, 16 and 29).

Discussion

A problem of importance in the control of hepatic coccidiosis in the rabbit is the carrier animal. The disease, chronic in nature, has a protracted course. Infected animals continue to eliminate oocysts in volume for long periods of time, in consequence of which the environment is subject to continual contamination from the droppings of infected rabbits. A medi-

TABLE I—EFFECT OF SULFONAMIDE MEDICATION UPON INFECTION WITH *E. stiedae*.

Trial	Rabbit	No. of Oocysts	% Drug in Water	Days After Infection Med. Began	Med. Ended	Necropsy	Condition of Liver and Remarks
1	1	500,000	0.030 SQ*	0	5	26	Very severe coccidiosis
	2	"	0.030 SQ	0	5	26	Very severe coccidiosis
	3	"	0.030 SQ	0	10	31	Normal
	4	"	0.030 SQ	0	10	31	Normal
	5	"	0.030 SQ	0	15	36	Few active lesions
	6	"	0.030 SQ	0	15	36	Few active lesions
	7	"	0.030 SQ	0	15	36	Normal
	8	"	0.030 SQ	0	20	41	Normal
	9	"	0.030 SQ	0	30	46	Normal
	10	"	None			19	Animal died from coccidiosis
2	11	500,000	0.025 SQ	10	15	15	Very severe coccidiosis
	12	"	0.025 SQ	10	15	37	Severe coccidiosis
	13	"	0.025 SQ	10	20	20	Very severe coccidiosis
	14	"	0.025 SQ	10	20	42	Few active, many healed lesions
	15	"	0.025 SQ	10	25	46	Normal size. Healed lesions
	16	"	0.025 SQ	10	30	51	Normal size. Healed lesions
	17	"	None			10	Very numerous lesions
3	18	150,000	0.025 SM*	0	10	30	Few active lesions
	19	"	0.025 SM	0	10	30	Normal
	20	"	0.025 SM	0	15	34	Severe coccidiosis
	21	"	0.025 SM	0	15	34	Normal
	22	"	0.025 SM	10	20	40	Severe coccidiosis
	23	"	0.025 SM	10	20	40	Severe coccidiosis
	24	"	0.025 SM	10	25	45	Normal size. Healed lesions
	25	"	0.025 SM	10	25	45	Normal size. Healed lesions
	26	"	0.025 SM	10	30	49	Few active lesions
4	27	500,000	0.025 SQ	30	45	65	Healed lesions. Oocysts present
	28	"	0.025 SQ	30	45	65	Healed lesions. Oocysts not found
	29	"	0.025 SQ	30	50	70	Healed lesions. Oocysts present
	30	"	None			65	Numerous lesions. Oocysts abund.
	31	"	None			75	Lesions regressive. Few Oocysts

*SQ—Sulfaquinoxaline; SM—Sulfamerazine

cant which would, when applied to infected animals, eliminate the carrier state, should prove of benefit in the control of this infection, and conceivably might accomplish its eradication in well-managed rabbitries. Sulfonamides may prove to be such medicinal agents. Our studies have indicated the lowest, fully effective level of either sulfaquinoxaline or sulfamerazine in the water to be near 0.02%. In order to assure a sufficient margin of safety, we suggest the use of either drug as 0.025 or 0.03% of the drinking water.

The data in table 1 indicate the minimum length of the medication period, both for prophylaxis and therapy against *E. stiedae* infection, to be approximately two weeks. Maximum or near maximum effect appears to be secured after three weeks of medication. Our data do not entirely clarify the matter as to whether the administration of either drug for a three-week period would eradicate the infection from the liver and thus eliminate the carrier state. Complete prophylaxis was attained in the case of rabbits 8 and 9, where medication was begun simultaneously with infection. Rabbit 9 was medicated for 30 days. The same result was secured with rabbit 16, where the onset of medication was delayed ten days. In the case of the corresponding animal 26, where sulfamerazine was substituted for sulfaquinoxaline, a few active lesions were still present at necropsy. Medication applied in an advanced stage of the disease (rabbit 29) was of marked benefit. The liver contained innumerable healed lesions, but some oocysts could still be found, indicating that some coccidial colonies survived the medication period. We should point out, however, that the disease exposures in our experimental animals were many times those which would normally occur under field conditions. It might be anticipated, therefore, that treatment of infected groups of rabbits may yield even better results than those attained in our experimental animals.

We have not had opportunity to make field tests of the use of sulfonamides in the control of hepatic coccidiosis in naturally occurring outbreaks. We suggest, however, the following procedure: In infected herds, medicate all weaned animals with 0.025 to 0.03% sulfaquinoxaline or sulfamerazine in the drinking water for three weeks. During the treatment period, clean and scald, if possible, all hutches, nesting boxes, water pans, feed containers, etc. Such treatment may be expected to benefit all animals in any stage of the clinical disease. If the medication does not eliminate the infection from every animal, at least it will greatly reduce the number of active lesions and thereby enormously suppress oocyst elimination. Contamination of the premises will be reduced accordingly. One treatment of this nature, supplemented with an effective cleaning program, should, theoretically, accomplish the elimination of hepatic coccidiosis as a clinical disease from any rabbitry. One should be able to maintain this condition indefinitely by good management practices, for hepatic coccidiosis in the rabbit is not difficult to control by good sanitation procedures. We would regard the use of sulfonamides as an adjuvant to sanitation in the control of this disease. The results of field trials may somewhat alter these concepts.

Regarding toxicity, none of our rabbits showed apparent evidences of toxicity up to 30 days of treatment, the longest observation period. All animals consumed the medicated water readily. Effect upon growth, if any, was slight. We know nothing regarding the possible effect of sulfonamide medication upon phases of reproduction.

Regarding the choice of a sulfonamide, we found sulfaquinoxaline and sulfamerazine to exert near identical activity, although the data in table 1 might indicate a slight advantage for sulfaquinoxaline. In one brief and inconclusive trial, sulfapyrazine showed activity comparable with sulfaquinoxaline. Sulfamethazine, however, was somewhat inferior to the latter drug under the conditions of the particular test. We suggest that drug selections be limited to sulfaquinoxaline or sulfamerazine.

Conclusions

1. In trials involving 46 rabbits, either sulfaquinoxaline or sulfamerazine administered continually as 0.02% of the drinking water was sufficient to inhibit the development of hepatic coccidiosis in rabbits heavily exposed to infection with *Eimeria stiedae*. The animals were sacrificed at the end of three weeks. Lower concentrations of either drug gave inconsistent results.

2. A minimum duration of sulfonamide medication for about three weeks was necessary for maximum effect either in the prophylaxis or therapy of the infection.

REFERENCES

1. Jankiewicz, H. A., Liver Coccidiosis Prevented by Sulfasuxidine. *Jour. Parasit.*, 31 (Supplement):15, 1945.

2. Horton-Smith, C., The Treatment of Hepatic Coccidiosis in Rabbits. *Vet.. Jour.*, 103:207, 1947.

3. Chapman, Merwyn P., The Use of Sulfaquinoxaline in the Control of Liver Coccidiosis in Domestic Rabbits. *Vet. Med.*, 43:375 (Sept.), 1948.

EDITORIAL COMMENTS

Diseases of Newborn and Young Pigs

Losses among the newborn of all meat-producing animals limit profits to growers. In the case of swine culture, it is reported that 30% or more of pigs that are farrowed fail to reach weaning age. An additional loss is sustained during the period from weaning to slaughter age and weights. The same situation exists among growers of beef and dairy cattle. In cattle, mortality statistics in the young are reported to be approximately 20%. This significant mortality is not the entire loss sustained by growers. Losses suffered by slow growth and weight gains that are due to mismanagement or disease processes cannot be estimated accurately.

On page 141 of this issue, Dr. George A. Young, Jr., associate professor of veterinary medicine at the University of Minnesota, Hormel Institute, Austin, Minn., presents the latest information on influenza in swine. This condition has been responsible for grave losses in young pigs.

It has been the observation of many practitioners that their clients are consulting them more in relation to animal husbandry practices, which include feeding and management of all types of livestock. Growers should be encouraged to seek qualified advice in relation to these considerations. Unscrupulous peddlers of drugs, tonics, conditioning powders, etc., continue to visit livestock growers, convincing the unwary, by extravagant claims, that the use of one or more proprietaries offered will solve their loss problems, increase average size of litters or rate of gain. These persons are frequently not qualified by training or experience to give advice and in some instances may be considered the modern counterpart of the snake oil medicine peddler of the past. It is important that the entire situation be surveyed in the light of the service veterinarians are prepared to give to the swine husbandryman. The problem of reducing losses in the newborn and baby pigs offers a matchless opportunity to demonstrate the value of veterinary service to the farmer, to assist him in raising a greater number of the pigs farrowed for more profitable swine breeding and feeding.

▼ ▼ ▼

Migratory birds, according to Cabot (*Vet. Rec.*, 57:375, 1945) apparently play an important role in the recrudescences of foot-and-mouth disease in Britain.

The American Animal Hospital Association extends a hearty welcome to all veterinarians to attend the annual meeting which will convene at the Hotel Shirley-Savoy, Denver, Colo., April 24-27. Dr. J. Stuart Crawford, New Hyde Park, N. Y., is the president of this active association and Dr. Wayne H. Riser, executive secretary.

▼ ▼ ▼

Food Producing Livestock or Game

The sheep industry in the United States has declined from a point in 1883 when there were 50,000,000 stock sheep and lambs to a recent low estimated at 28,000,000.

In an analysis of the reasons for this loss in sheep numbers, Howard Vaughn, president of the National Wool Growers Association, asserted that the real cause of depletion has resulted from government action under policy of land management in the Western States, (*National Provisioner,* March 4, 1950). He deplored governmental policy of setting aside public lands formerly used for sheep grazing for elk, antelope and other game, and prohibiting sheep grazing in park and forest preserves as a wasteful method of food production.

To assure firm supply of sheep products in this country, range grasses must be used to the best possible advantage.

Grazing by cattle and sheep offers the only reasonable use of grass on the immense western ranges and in a portion of this sheep only can profitably harvest the native vegetation for the production of meat, wool and many valuable by-products of the sheep industry.

▼ ▼ ▼

Blood Test for Tuberculosis

A hemagglutination test for serum antibodies to products of tubercle bacilli is reported by Scott, *et al.*, (*Jour. Lab. and Clin. Med.*, 35:303 [Feb.], 1950) that indicates a specific antibody reaction in tuberculosis in man. Though requiring careful technic, the test can be performed in a half-day's time, and be read the following morning. The authors express the hope that the procedure will assist in establishing the presence of infections in human patients and differentiating false positives and atypical reactions to the skin tests employed in human medicine. It offers possibilities in veterinary medicine to supplement sensitivity tests.

Animal Protein Factor—Utilization of Feed

Nearly all commercial feeds contain the animal protein factor (APF). Of interest is a report from the University of British Columbia that an adequate amount of APF may express its greatest value in improved efficiency of feed utilization. Experimental lots of chicks, fed rations containing this factor, made gains over a similar lot of controls, which would represent a 19% saving in the amount of feed required to produce equal gains.

The work demonstrates that not only average gains but economy in terms of quantity of feed consumed per pound of gain must be considered in the evaluation of the APF supplementary feeding.— *N. J. Farm & Garden,* February 1950.

▼ ▼ ▼

Nutrition is the most important single environmental factor affecting animal health.

Air Transportation Creates New Problems

Ever increasing foreign commerce by land, sea, and air adds to the problem of supervising points of entry. Passenger-carrying planes and ships are considered a greater potential danger than cargo planes or ships. Commercial shippers are aware of import restrictions as applied to meat and animal products.

According to the annual report of the Chief of the BAI for 1949, European tourists insist upon bringing in a favored bit of sausage or other cured meat for friends or themselves. On a spot check in the port of New York last spring, 17,146 pounds of meat were taken from passengers arriving on 226 boats. The seizures ranged from a few ounces of sausage to half a hog.

▼ ▼ ▼

According to the U. S. Fish and Wildlife Service, the organism causing fowl cholera does not live in the soil.

Plan now to attend the A.V.M.A. Miami Beach Convention, August 21-24, 1950. In this aerial view of beautiful Miami Beach, looking northward from a point just south of 26th street, the diagonal outlines of the ocean front, famed Collins Avenue, and equally famous Indian Creek, provide a novel study in parallels. The buildings shown along the beach are for the most part luxurious hotels where summer rates are often as low, or lower, than average accommodations in other convention cities.

POULTRY PRACTICE PROBLEMS

W. R. HINSHAW, D.V.M., Ph.D.
Frederick, Maryland

In the August, 1948, issue of VETERINARY MEDICINE (page 348), the writer reviewed the etiological status of infectious sinusitis of turkeys to that date. Since then a number of reports have been published to support the evidence that the disease is caused by an agent which filters with difficulty. Groupé and Winn (*Jour. Bact.* 57:515, 1949) have summarized this information and have described a coccoid-like agent which resembles the Chlamydozoaceae (the lymphogranuloma-psittacosis group of organisms). They were able to demonstrate the agent only in infected yolk sac tissue having a titer of LD_{50} of $10^{-6.0}$ and greater.

The agent described by them produced sinusitis only when injected directly into the sinuses of turkeys. It was not pathogenic for chickens, pigeons or mice. Sulfadiazine and penicillin, in fairly high concentrations, did not affect the agent, but it was definitely inhibited by streptomycin and aureomycin.

The agent was cultivated with ease in the yolk sac of the chicken embryo and with some difficulty in the allantoic sac and on the chorioallantois.

▼ ▼ ▼

Schneider and Gunderson, (*U. S. Egg and Poultry Mag.*, 55:10, July, 1949), have added data to that previously reported to show that fowl are a source of the human types of Salmonella. In this report they demonstrate the possibility of spread of such infections in poultry dressing plants. In an examination of 1,014 eviscerated chickens picked at random in one plant, 4.4% of the birds yielded one or more of four Salmonella types. The types isolated in their order of frequency were *S. pullorum, S. anatum, S. meleagridis,* and *S. monteviedo.* The skin of frozen storage birds showed significantly smaller numbers of Salmonella than that of freshly chilled birds. All the chickens examined appeared to be normal.

▼ ▼ ▼

Do not fail to read Doctor Beaudette's excellent review on Twenty Years of Progress in Immunization Against Virus Diseases of Birds, appearing in the October and November 1949 issues of the *Journal of American Veterinary Medical Association* (pages 232 and 367). This paper, which was presented at the Detroit meeting of the A.V.M.A., is packed with so much information that it would be impossible to adequately review it in the space available. Two other papers, also presented at the same meeting and published in the October issue are, A Quarter Century of Poultry Pathology in North America, by Doctor Stafseth (page 249) and Progress in Infectious Bronchitis Research, by Doctor Delaplane (page 257).

▼ ▼ ▼

In trials conducted at the University of California, turkeys inseminated with 1/40 cc. of undiluted semen maintained 90% fertility for three weeks. During the fourth week, fertility declined slowly and by the end of the eighth week disappeared entirely. When the amount of semen was reduced to 1/80 cc., the percentage of fertile eggs began to drop abruptly after two weeks.

▼ ▼ ▼

Freezer burn in poultry can be prevented by proper handling of the carcasses before and after putting them in the freezer. Wrapping the birds in moisture-proof paper and then carefully sealing the package is essential. Care must be taken to avoid breaking the seal or injuring the package, which allows air to get to the carcass. A relatively high humidity maintained in the freezer will also aid in preventing freezer burn.

▼ ▼ ▼

The latest developments in the diagnosis of Newcastle disease (avian pneumoencephalitis) are two rapid plate technics for making the hemagglutination-inhibition tests. These are a rapid serum method described by Luginbuhl and Jungherr (*Poult. Sci.*, 28:623, 1949) and a rapid whole blood method described by Zargar and Pomeroy, (*Jour. Am. Vet. Med. Assn.*, 115:354, 1949).

▼ ▼ ▼

Oocysts of *Eimeria tenella,* the coccidia that produce cecal coccidiosis of chickens, survived 48 weeks on the ground in deep shade and 41 weeks in areas that were unshaded or partly shaded. In consideration of these prolonged survival periods, it may be seen that premises occupied by infected birds remain infective for susceptible poultry for long periods unless special measures are taken to make such premises safe.

▼ ▼ ▼

A Chicago cosmetic firm is advertising a new shampoo which contains fresh whole eggs.

PRINCIPLES OF ANIMAL HEALTH

R. R. DYKSTRA, D.V.M.
Manhattan, Kansas

The "lambing paralysis" (ketosis of ewes) season is again approaching. A light grain ration for the first third of pregnancy, with a heavier grain ration after this, that is, enough to keep well ahead of the developing lambs, with exercise daily, enforced if necessary, will usually safeguard the breeding flock against this serious malady. If not, the addition to the ration of up to four ounces of molasses daily, less if this causes scouring, will handle an impending, or the early stages of an already existing, outbreak. The Ross urine test will demonstrate the presence of ketones before clinical symptoms of the disease make their appearance or losses occur.

▼ ▼ ▼

During recent times comparative anatomists have obtained truly beautiful results in outlining the blood circulation in various organs by injecting a synthetic latex, and then dissolving the soft tissues in an acid medium so as to leave, in latex, a perfect reproduction of the organ's circulation. However, medical history records that an almost identical technic for duplicating the form and distribution of the bronchi and bronchioles was practiced more than 200 years ago by an English clergyman and physiologist, the Reverend Doctor Stephen Hales, when he filled the bronchi and bronchioles of dried dog's lungs with barely molten lead, and then permitted the soft tissues to macerate away. It is recorded that by this method he obtained, ". . . a perfect cast in lead of the bronchial tree, down to its very finest twigs."

▼ ▼ ▼

A farmer cat owner related that during recent years most of the kittens born on his farm died before they were three months of age. The symptoms described included a mucopurulent nasal discharge, difficult breathing, coughing, vomiting and diarrhea. The tentative diagnosis, panleukopenia (feline distemper). He was advised to seek professional assistance so that specific antiserum might be administered in the early stages of the condition. Also, if the kittens were free from evidences of the ailment shortly after weaning prophylactic vaccination with feline distemper vaccine might provide adequate protection on exposure. Disinfection of the usual quarters of the cats by burning all litter and old bedding, and disinfection of woodwork and utensils with a hot disinfectant (not phenol which has a very low rating in its effect on viral conditions) was also recommended.

▼ ▼ ▼

During a recent conference of veterinarians at the Ontario Veterinary College, Rhodes, of the University of Toronto, outlined four methods that are now available to assist in attempts to diagnose virus diseases. They are: (1) microscopy, by use of the electron microscope; (2) chick embryo cultivation, as most viruses grow well in this media; (3) inoculation of laboratory animals, with a reproduction of the disease under investigation; (4) serological tests or a testing of the immune bodies developed during a viral disease by the virus neutralization, and complement fixation methods.

▼ ▼ ▼

A practitioner specializing in the treatment of ailments of pet animals informed us that it is dangerous during treatment to permit more than walking exercise in those canine patients that are receiving fuadin medication in the treatment of heartworm cases, because fragments of the dead parasites may produce fatal embolism during severe exercise.

▼ ▼ ▼

A visitor, who owns only a few animals, sought advice regarding two sows that had very little milk for their pigs at farrowing time and in which ten days later all milk secretion had ceased. The pigs would have died if artificial feeding had not been adopted. The owner wanted to know whether this agalactia was likely to be repeated at subsequent farrowings. Inquiry brought out the facts that the sows had received only corn as the grain ration, supplemented by prairie hay and such other roughage as they could pick up in the yard. The addition of protein to the ration was suggested preferably as tankage, or at least as cottonseed meal, linseed cake or alfalfa or suitable combination of these high protein foods. With such improvement in the ration the owner was assured, that providing the sows are otherwise in good health, the milk supply would be ample for nursing the young.

VETERINARY PARASITOLOGY

A. O. FOSTER, B.A., M.A., Sc.D.
Beltsville, Maryland

Dusting for Sheep Ticks

Experiments in Wyoming[1], although preliminary, suggest that the proper application of a 0.5% rotenone dust may afford reasonably satisfactory control of the sheep tick, *Melophagus ovinus*. The method involves special chute and nozzle arrangements, and rapid power dusting. It is especially designed for large-scale, post-shearing operations on the range, where there may be a shortage of water for dipping or spraying, and when there is objection to wetting because of possible change to cold weather. Sheep growers and practitioners who are interested in this development should consult the Wyoming Experiment Station for specific formulations and details of application.

▼ ▼ ▼

Veterinary Parasitology in Venezuela

Studies published during 1948[2] from the School of Veterinary Medicine, Caracas, Venezuela, dealt with such varied parasitological subjects as demodectic mange of swine caused by *Demodex phylloides*, giant kidney worm infestations of dogs, *Physocephalus sexalatus* in a sloth, horse bots, hydatid disease of camels, human parasitism with the dog tapeworm (*D. caninum*), and miscellaneous parasites of domestic and wild animals. Of 11 articles in the *Revista*, seven are wholly on parasites.

Demodex phylloides is reported for the first time from Venezuela. It multiplies in the sebaceous glands, and a single pustule contains from 50 to 1000 parasites. The infection is highly contagious and apparently quite common, although affected pigs show no evidence of injury or debilitation on account of the condition. A case of renal parasitism with *Dioctophyma renale* is described in a dog from Argentina and appears to be the fourth such case reported from this country. *Physocephalus sexalatus*, a common stomach parasite of swine, is reported for the first time from the sloth. The case originated in Panama (collected by this reviewer), and is described by Dr. Eduardo Caballero y C. of Mexico. The three common species of horse bots occur in Venezuela and are apparently well established, although they appear to have been brought into the country comparatively recently. Several formulations of treatments against bots are reviewed.

The reports are fully and well illustrated, and contain especially informative discussions of the biology of the parasites discussed.

▼ ▼ ▼

Quaternary Ammonium Compounds

Studies at the University of Georgia* have shown that quaternary ammonium compounds, so effective in destroying bacteria and fungi, have no place in the control of large roundworms of chickens. Following upon the discovery that rations containing small amounts of these chemicals (1:2,000 of a mixture containing 5% alkyl-dimethyl-benzyl-ammonium chloride and 5% alkyl-dimethyl-dichlor-benzyl-ammonium chloride) promoted the growth of chicks, it was found experimentally that such rations also promoted the development of roundworms. At four weeks of age, and three weeks after experimental infection, 54 infected chickens raised on the medicated diet had an average of 15 worms each, while 55 control chickens averaged less than ten. Individual treatments (single doses of 0.6 to 5.0 cc. of the aforementioned mixture) were toxic but not demonstrably anthelmintic in trials on twenty eight-week-old chickens.

▼ ▼ ▼

In an experimental study of ascarid infections§§, weight gains of four parasitized and four unparasitized pigs were recorded during the period from two to 20 weeks of age. The latter averaged 0.79 pound (0.75-0.86) daily for 126 days. The four pigs that were experimentally infected with ascarids averaged 0.72, 0.47, 0.39, and minus 0.06 pound daily. At autopsy, after 126 days, they harbored respectively 12, 20, 39, and 109 ascarids. Each adult ascarid, on the average, was responsible for depressing the rate of gain by more than one pound (actually 1.16) before the pigs reached five months of age.

---

[1]Denning, D. G., Dusting for Sheep Tick Control. *Jour. Econ. Ent.*, 42(5):852-853, 1949.

[2]*Revista de Medicina Veterinaria y Parasitologia*, 7:1-4 (Jan.-Dec.), 1948.

*Riedel, B. B., Barber, C. W., and Hays, T. A. S., The Anthelmintic Activity of Quaternary Ammonium Compounds in Chickens Infected with *Ascaridia galli*. *Poul. Sc.*, 28:830-833, 1949.

§§Spindler, L. A., The Effect of Experimental Infections with Ascarids on the Growth of Pigs. *Proc. Helm. Soc. Wash.*, 14:58-63, 1947.

ABSTRACTS OF LITERATURE

Experimental Effect of Aureomycin in Leptospirosis

In *in vitro* tests on the influence of aureomycin[16] the authors found that one-tenth microgram per cubic centimeter of cultural medium completely inhibited the growth of Leptospira.

In tests on the therapeutic effect of aureomycin on carriers, 50 hamsters infected with *Leptospira canicola* were treated with penicillin. Of these 45 survived, 20 of which on necropsy proved to be renal carriers. The remaining experimental animals were given 1 mg. of aureomycin in saline every eight hours by intraperitoneal injection. Two days following aureomycin treatment, all hamsters proved to have sterile kidneys.

Oral administration of aureomycin to four dogs experimentally infected, and which were shedding Leptospira, indicated the value of this antibiotic in preventing carriers. Two of these dogs were given 20 mg. of aureomycin every twelve hours (or 5 mg. per kg. body weight) for three days. One of these remained a carrier. Urine from the other two animals given 150 mg. every 12 hours (40 mg. per kg. body weight) for three days did not contain Leptospira two days after treatment and remained free of these organisms for 30 days.

These trials reflect the value of aureomycin in the larger doses for the prevention of a carrier state of leptospirosis infection.

▼ ▼ ▼

Canine Hysteria not Induced Experimentally in Dogs Fed Flour Bleached with Chlorine Dioxide

The U. S. Food and Drug Administration removed nitrogen trichloride (agene) from the list of approved bleaching agents for flour, though it has been used widely in this country for 25 years. Since the endorsement of chlorine dioxide as a bleaching agent, its effect when included in the diet of young and mature dogs is reported[14]. No clinical abnormalities were produced in a group of 12 dogs when fed, for periods ranging from 147 to 355 days, diets containing treated (ClO_2) flour as a major ingredient. Young dogs made fairly good gains during the test period and mature animals were maintained satisfactorily.

Four dogs receiving a diet containing agenized flour developed symptoms of canine hysteria, the time required and the severity of symptoms was in direct proportion to the amounts of agene fed.

Under conditions of the experiment, flour treated with chlorine dioxide as a bleach does not provoke canine hysteria.

▼ ▼ ▼

Infectious Keratitis in Cattle

Keratitis is an infectious disease peculiar to cattle, the primary lesions of which are confined to the cornea and conjunctiva[15].

The disease, causing loss of weight in affected cattle, is widespread over much of the southwestern range country. Keratitis usually appears in a herd suddenly, giving no warning nor clue to its origin. The disease affects all ages and breeds. Infection causes photophobia, lacrimation, cloudiness of the cornea, impairment of vision, injection of corneal blood vessels and conjunctivitis.

The authors state that the etiologic factor or factors have not been determined and that treatment must be symptomatic. Therapeutic measures of value include dusting with powders containing sulfonamides and urea, or the instillation of sulfathiazole ointment. The use of old standby remedies is mentioned as having merit, including boric acid solution, argyrol, silver nitrate, calomel, and mercurochrome.

▼ ▼ ▼

In a study of the variations in the bactericidal and bacteriostatic properties of milk, McEwen and White (*Vet. Rec.*, 62:27 [Jan. 21], 1950) found that the infusion of quarters with saline cultures of streptococci commonly associated with bovine mastitis failed to establish permanent udder infection and that reactions caused by such infusions were temporary.

▼ ▼ ▼

Shifting lameness in horses may be due to bursitis caused by brucellosis infection.—W. M. Coffee, D.V.M.

[16]Brunner, K. T., D.V.M., and Meyer, K. F., D.V.M., M.D., Effect of Aureomycin on *Leptospira canicola* and *Leptospira icterohaemorrhagiae in vitro* and Experimental Carrier studies. *Am. Jour. Vet. Res.*, 11:89 (Jan.), 1950.

[14]Nakamura, Frank I., and Morris, Mark L., Effect on Dogs of Feeding Flour Treated with Chlorine Dioxide and Nitrogen Trichloride. *Cereal Chem.*, 26:501 (Nov.), 1949.

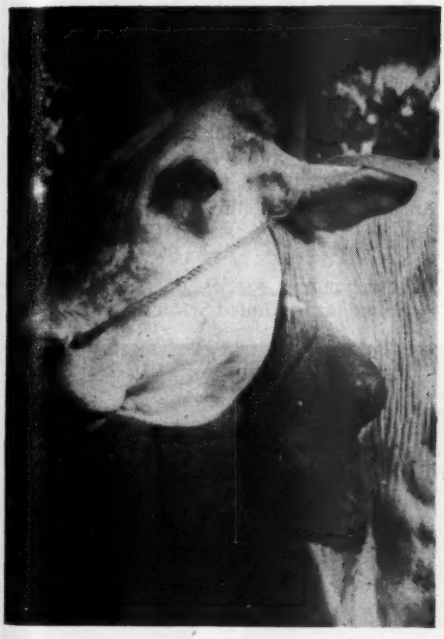
[15]Farley, Herman, D.V.M., M.S., Kliewer, I. G., A.D., Pearson, C. C., D.V.M., and Foote, Lon E., D.V.M., Infectious Keratitis of Cattle. *Am. Jour. Vet. Res.*, 11:17 (Jan.), 1950.

CLINICAL REPORTS

Large Melanoma in a Bullock

C. A. McGAUGHEY, Professor of Veterinary Science, University of Ceylon, Colombo.

The subject, a crossbred, grey-roan Hissar-Scindi bullock, 15 years of age, was presented at the clinic with a large tumor suspended from the neck as shown in the accompanying illustration.



The owner stated that the tumor had been growing for the past ten years. At the time of removal, it measured about 12 inches long and nine inches in diameter; it was ovoid in shape and pedunculated, the pedicle being a fold of skin with its base around the left ear. The skin of the pedicle was normal although rather thin, but as it continued over the tumor, became hairless and scaly; the distal pole of the tumor was covered with horny projections. Despite the heavy weight of the tumor (20 lb.) the animal appeared to suffer little inconvenience and had been used for draft on the farm. The tumor was wrapped in sacking to protect it from flies.

The neoplasm was removed under local anesthesia and the skin sutured with silk thread. Sulfanilamide-flovine-sulfate powder was applied to the wound, and a dressing of margosa and citronella oil to the surrounding skin to repel flies. After six days, when the sutures were removed, the skin was healing by direct union.

On longitudinal section, the tumor was found to be very firm and tough, almost wholly jet black except for a band of white tissue four inches long and two inches broad at one side and a greyish area about three inches by three inches on the opposite side. There was no sign of necrosis and there appeared to be a good blood supply.

Microscopically, prepared slides of tumor tissue appeared as round cells packed with minute granules of dark brown pigment; much extracellular pigment was noted in granular form, a supporting framework of fibrous tissue and blood vessels. No mitotic figures were observed. In consideration of these findings, a diagnosis of simple non-malignant melanoma was made.

▼ ▼ ▼

Stethoscopic Heart Record

A phonograph record produced by Columbia Recording Company is a comprehensive study of heart sounds, murmurs and arrhythmias in man. George D. Geckler, M.D., who has developed the work gives an explanatory commentary as the auscultatory sounds are reproduced. All sounds were checked electrocardiographically.

The record was developed primarily for the physician who has been practicing for a number of years, but it obviously has value for the teacher and student. A unique feature is that it was produced so that one might listen with a stethoscope. The volume is then adjusted so that the spoken voice is just heard distinctly; this results in a normal level of intensity for the sounds and murmurs of the illustration. One can listen to the record as any other recording or it might be played before study groups.

The record may have little practical value for veterinarians but it is of tremendous scientific interest and might well serve as a precedent for a similar reproduction of pathological sounds in cardiac diseases to which animals are subject.

Local music or record shops can supply either the standard album at $7.97 or the long playing record at $4.85.

VETERINARY ITEMS OF INTEREST

A bill to provide state aid to counties in which rabies in wildlife is a threat to human beings and domestic animals, has been introduced in the New York State Legislature. Though the appropriation to implement the provisions of the bill are small, the measure reflects the attitude of this legislative assembly in disease control. During the past year, 276 rabid foxes were reported in upstate New York and 172 cows died of rabies.

▼

There are 79 medical schools now approved by the Council on Medical Education of the A.M.A., with an estimated total enrollment of 24,800 students.

▼

Cattle number is reported by the USDA to have increased in the United States during 1949 by nearly 2,000,000 head, or approximately 3%.

▼

The horse breeding industry in the United States is valued at 200 million dollars.

The usually recommended dust-bath materials for chinchillas are either very fine volcanic ash, fine beach sand, beach sand mixed with powered talc, and clean local soil in the form of dry dust.

▼

Lauritz Melchior, one of the greatest of all Wagnerian tenors, has accepted the general chairmanship of National Dog Week for 1950, to be observed September 24-30 this year.

▼

An invitation to veterinarians to submit nominations for the 1950 Humane Act Award of the A.V.M.A. has just been issued by officials of the national association.

▼

Estimated livestock production in Los Angeles County, California, totals $117,719,-083. for 1949.

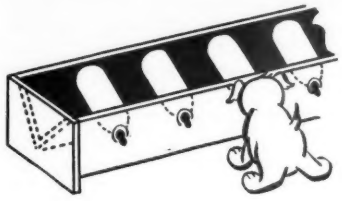
▼

Five hundred species of fleas have been identified in the United States.

Dr. C. P. Zepp (right), New York City, president of the A.V.M.A., was voted Veterinarian of the Year 1949 in a national poll conducted by the Gaines Dog Research Center. Shown above, Doctor Zepp receives his "Fido" from Harry Miller, director of the center, at ceremonies held recently in New York City.

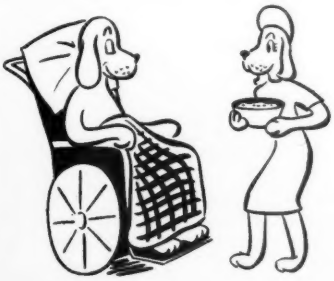
Avoid canine crises with

BORDEN'S ESBILAC



1. Let Borden's *Esbilac* save puppies whose mother dies or cannot nurse the full litter. This product of Borden's nutrition research closely resembles natural bitch's milk. It has saved the lives of thousands of puppies.

2. For pregnant or lactating bitches, *Esbilac* also can be a life-saver. Fed as a supplement to their regular diet, *Esbilac* helps produce more live puppies per litter, more milk for the pups and a quicker recovery for the mother.



3. Pep up sick, convalescent or aging dogs with this concentrated nutrient. Readily eaten, concentrated and easily digested, Borden's *Esbilac* may be fed as a supplement or as a liquid formula to restore appetites and health.

4. The same Borden scientists who solved some of the greatest problems in human nutrition developed *Esbilac* (original formula 107-A). It's the perfect replacement for bitch's milk. Write for full information and simple feeding directions.

From the same research that produces *Esbilac* comes

Borden's Dog Food

Meal & Chunx (Pellets).

Formulated with the same know how and care as *Esbilac* —with its quality safeguarded by rigid laboratory and biological testing. Write for a professional sample today!

THE BORDEN COMPANY

Dog Food Department

350 Madison Avenue, New York 17, N. Y.

"IT'S ALL YOU NEED FOR ANY BREED"

© The Borden Company